

ITI LIMITED
(A Govt. of India
Undertaking)



Expression of Interest
For
Design, Supply, Installation, Commissioning,
Operations and Maintenance
of Intelligent Transportation Systems in a metropolitan city

Tender Notice No: ITI/MSPDelhi/2K22/ITS/1 Date: 11.05.2022

Deputy General Manager
ITI Limited, MSP-Delhi
Core -1, 11th Floor, Scope Minar,
Laxmi Nagar, Delhi-110092
Email: kiransingh_nsu@itiltd.co.in
Website: www.itiltd.in



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(A Govt. of India Undertaking)
Deputy General Manager

ITI Limited, MSP-Delhi

Core-1 Floor-11

Scope Minar Laxmi Nagar,
New Delhi-110092

Email: kiransingh_nsu@itilttd.co.in

TENDER NOTICE

Tender Notice to: **ITI/MSPDelhi/2K22/ITS/1**

Date: 11.05.2022

ITI Limited invites ONLINE bid in TWO COVER SYSTEM (Technical & Financial) from eligible bidders which must be valid for a minimum period of 120 days from the date of bid opening for following items:

Scope of Work	Design, Supply, Installation, Commissioning, Operations and Maintenance of Intelligent Transportation Systems in a metropolitan city
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Interested parties may view and download the tender document containing the detailed terms & conditions from the websites Tender Wizard Portal, [CPP Portal](#) OR <http://itilttd.in>

The ONLINE bid is to be submitted in a sealed cover over the Tender Wizard ITI Limited Portal

The helpdesk nos. for bidding:

- a) **Shri Prashant Kumar: +91-99100-48364**
- b) **Shri Abhay Sharma: +91-78274-50462**

M/s ITI Limited

DGM MSP Delhi

Subject: Expression of Interest (EoI) for Design, Supply, Installation, Commissioning, Operations and Maintenance of Intelligent Transportation Systems in a metropolitan city

We as a Govt. of India Undertaking organization under the Ministry of Communication & IT engaged in ICT business along with other diversifying business areas.

This EOI/RFP/Tender is aimed at identifying suitable Commercial Organization as a 'System Integrator' having adequate strength in the above field.

The 'System Integrator' (SI) shall act as an OEM/System Integrator of ITI to execute the project in India. All mission critical activities would be managed and supervised by ITI through its experienced Managers and qualified Professionals in the respective areas.

With this vision and commercial objective, sealed bid is invited for the above-mentioned work. The Sealed Technical and Financial proposal under Two Cover-System may be submitted by the Bidder(s). It is must for the bidders to meet the Eligibility Criteria as mentioned in the EoI/RFP/Tender document.

The interested parties may collect the EoI/RFP/Tender document upon submission of EoI/RFP/Tender Document Cost to ITI by person or the same can be downloaded from the website and the said cost may be submitted along with the bid at the time of submission of offer.

Few important points & timelines are being furnished hereunder.

Sl. No.	Important Points / Timelines	Details
1	EoI/RFP/Tender Enquiry Authority	DGM MSP Delhi ITI Limited, MSP-Delhi Core-1 Floor-11 Scope Minar Laxmi Nagar, New Delhi-110092 Email: kiransingh_nsu@itilttd.co.in
2	Contact Person for the clarification of EoI/RFP/Tender Document	a) Ms Abha Contact: email id: etenderiti_mspdli@itilttd.co.in
3	Tender Type (Open/Limited)	Open Tender
4	No. of Cover/Package	Two Cover System
5	Tender Category (Goods/Services/Works)	Goods
6	Payment Mode (Online/Offline)	Online RTGS/ NEFT Bank: Bank of Baroda, KG Marg MICR: 110012021 IFSC: BARB0CURZON Acc. No.: 06230500000010
7	EoI/RFP/Tender Document Cost (inclusive of GST)	Rs. 75,000/-
8	EMD Amount	Rs. 10 crore
9	Estimated Value of Enquiry	500 crore
10	Due Date, Time & Place for Sale of EoI/RFP/Tender Document	18.05.2022; 12:00 pm
11	Due Date, Time & Place for Submission of Bid	18.05.2022; 02:00 pm

12	Due Date, Time & Place for Opening of Technical Bid	18.05.2022; 02:00 pm
13	Due Date, Time & Place for Opening of Financial Bid	Will be intimated
14	Performance Security	As per the customer requirement

In order to get the clarity of the scope of work / terms & conditions, the bidders are requested to go through the whole EoI/RFP/Tender document and other project related requirements carefully. An explicit understanding of the requirement is rather essential for arriving at commercial assessment by the prospective bidders.

The selected bidder who is to play the role of a 'System Integration Associate (SIA)' has to enter in to a Contract with ITI Limited to form a case-specific business alliance (under sole investment business model) for arranging the requisite bidding inputs.

This EoI/RFP/Tender is being issued with no financial commitment and the response to this EoI/RFP/Tender shall not be assumed as mandatory for short listing of the suitable vendor with adequate experience for giving the work.

Deputy General Manager
MSP-Delhi

Project Background:

ITI Limited (ITI) is a Public Sector Undertaking which functions under the aegis of The Ministry of Communications and IT, Government of India.

We at MSP-Delhi (which is part of the Corporate Marketing Department located at Bangalore) are engaged in the business of Telecom / ICT and e-Governance projects implementation, Supply of Hardware and Software and the services related with these items.

ITI is interested in addressing some of the prospected business opportunities where it is strongly positioned by virtue of its 'PSU Status', proven 'Project Management Capabilities' and rich Relevant- Experience. ITI is looking for business association from reputed System Integrators/ OEMs who can assist ITI to win the business and ultimately help ITI in the execution of the project.

The objective of this Invitation for submission of bid is to identify a System Integration Associate (**SIA**) to address a particular 'Business Opportunity' / a kind of 'Business Opportunity' which has emerged or under process to emerge from a client for the implementation of a project in Government Domain.

The selected bidder who is to play the role of a 'System Integrator' has to enter in to a contract with ITI Limited to form a case-specific business alliance for addressing the opportunity.

During the bidding process, the vendor is supposed to provide the requisite Techno-commercial inputs to ITI as per the Requirements/Specifications/Expectations/Scope of Work of the prospective customer to win the commercial bid in favour of ITI. The name of the end-customer and other details of the Projects would be shared with the selected bidder.

On receipt of the Purchase Order, the same would be placed on the selected SI on back to back basis

Eligibility Criteria of the Bidders:

The bidders are to fulfill the following eligibility criteria **and submit documentary proof in this regard:**

S. No.	Clause	Documents Required
	Processing fees for the tender document (if any)	Rs. 75,000/-
	EMD	Rs. 10 crore

Eligibility and Qualification Criteria		
Factor/ Sub-Factor	Requirement	Documents
General Experience	The Bidder (single entity or JV member) shall have successfully executed/completed at least two (2) projects in transportation/transit/traffic/ICT systems with a minimum value of Rs. 100 Crs per project in last seven (7) years starting 1 st Jan 2014.	PO/ Completion Certificate
Specific Experience for ATCS with Automatic Subarea Formulation	The Bidder (single entity or JV member) shall have successfully commissioned/Go-Live of ATCS Systems with Automatic Subarea Formulation with at least two Customers/Clients in the last 7 years starting 1 st Jan 2014. The systems should have been in operations (DLP/AMC) for at least One (1) year post completion/Go-Live for each Customer/Client with the criteria mentioned below: A. Bidder should have supplied and integrated Central ATCS Platform for each Customer/Client of: (i) at least 500 Adaptive Traffic Signals and (ii) shall be of minimum value of USD two (2) million for each Customer/Client. OR B. The bidder should have Supplied and Implemented for each Customer/Client of: (i) at least 100 Adaptive Traffic Signals integrated with Central ATCS Platform and (ii) shall be of minimum value of USD two (2) million	PO/ Completion Certificate
Specific Experience for Traffic Information & Management System	The Bidder (single entity or JV member) shall have successfully commissioned/Go-Live Central Integrated Traffic Information & Management System (TIMS) Platform with at least two Customers/Clients in last the seven (7) years starting 1 st Jan 2014. The TIMS platform for each Customer/Client should have been integrated with at least three (3) of the following subareas for a city-wide / campus-wide deployment having minimum value of USD five (5) million and in operations (DLP/AMC) for at least one (1) year post completion/Go-Live: • City/Campus Surveillance with at least 100 cameras • Information Dissemination with at least 20 Variable Message Signs • Red Light Enforcement System with at least 100 Stop line violation detection cameras coupled with license plate recognition • Speed Enforcement System with at least 20 speed detection devices coupled with license plate recognition • Automatic Traffic Counters & Classification devices with at least 50 equipment	PO/ Completion Certificate
Specific Experience for City Bus System	The Bidder (single entity or JV member) shall have successfully commissioned/Go-Live with at least two Customers/Clients in last seven (7) years starting 1 st Jan 2014 with minimum value of USD two (2) million each and the systems should have been in operations (DLP/AMC) for at least one (1) year post	PO/ Completion Certificate

	completion/Go-Live for each Customer/Client with the criteria mentioned below: Bidder shall have successfully commissioned/Go-Live Intra-city CAD/AVL Systems integrated with real time Passenger Information System (PIS). Each CAD/AVL implementation should be controlling a fleet of at least 500 public transit vehicles.	
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manufacturers:

manufacturers for the following major items of supply or services must meet the following minimum criteria, herein listed for that item:

Item No.	Description of Item	Minimum Criteria to be met
1	ATCS Platform	Manufacturer shall have implemented at least 2 similar projects in last 7 years.
2	ATCS Controllers	Manufacturer shall have at supplied/deployed the same for at least 1000 intersections in last 7 years.
3	TIMS Platform	Manufacturer shall have implemented the same in at least 2 similar projects in last 7 years.
4	Variable Message Signs	Manufacturer shall have supplied/deployed at least 100 similar units in last 7 years.
5	Red Light Violation System	Manufacturer shall have supplied/deployed at least 200 similar units in last 7 years.
6	Speed Limit Violation Detection System	Manufacturer shall have supplied/deployed at least 200 similar units in last 7 years.
7	Automatic Traffic Counter & Classifier	Manufacturer shall have supplied/deployed at least 250 similar units in last 7 years.
8	CAD/AVL Application	Manufacturer shall have implemented the same in at least 2 similar projects in last 7 years.
9	Depot Management System	Manufacturer/ Sub-Contractor shall have implemented the same in at least 2 similar projects with 100 buses each in last 7 years
10	AVL Devices	Manufacturer shall have supplied/deployed at least 1500 similar units in last 7 years.
11	Passenger Information System	Manufacturer shall have supplied/deployed at least 100 similar outdoor units in last 7 years.
12	Video Wall & Controller	Manufacturer shall have at supplied/deployed at least 100 similar units last 7 years
13	Operation and Maintenance of TIMS	Sub-Contractor shall have experience at least 2 similar projects in last 7 years
14	Operation and Maintenance of CBS	Sub-Contractor shall have experience at least 2 similar projects in last 7 years

General Terms and Conditions of EoI/RFP/Tender:

The prospective bidders are advised to study the EoI/RFP/Tender document carefully. Submission of your offer/bid shall be deemed to have been done after careful study and examination of the EoI/RFP/Tender with full understanding of its implications. Failure to furnish all information required in the EoI/RFP/Tender Document or submission of an offer/bid not substantially responsive to EoI/RFP/Tender in every respect will be at the Bidder's risk and may result in its outright rejection.

The Bidder shall bear all costs associated with the preparation and submission of its Bid, including cost of presentation for the purposes of clarification of the Bid, if so desired by ITI Limited. In no case, ITI would be responsible or liable for those costs, regardless of the conduct or outcome of the Tendering Process. ITI reserves the right, not an obligation, to carry out the capability assessment of the Bidder(s). This right inter alia includes seeking Technical-Demonstrations, Presentations, Proof of Concept and Live-site visits etc.

1	Empaneled Vendor of ITI	Only ITI Empaneled Vendor (vendors who have signed the Empanelment Agreement with ITI on or before the submission of the tender/bid/proposal)
2	Non-transferable Offer	This EoI/RFP/Tender document is not transferable. Only those, who have purchased this offer document, are entitled to quote.
3	Only one Proposal	The Bidder should submit only one Bid/Offer/Proposal. If the Bidder submits or participates in more than one proposal, such proposals shall be disqualified.
4	Language of the Bid	All information in the Bid, correspondence and supporting documents, printed literature related to the Bid shall be in English. Failure to comply with this may disqualify a Bid. In the event of any discrepancy in meaning, the English language copy of all documents shall govern.
5	Clarification and Amendment in Tender	At any time before the submission of Proposals, ITI may amend the EoI/RFP/Tender document by issuing an addendum / corrigendum in writing or by standard electronic means. The addendum / corrigendum shall be sent to all contenders and will be binding on them. The Bidders shall acknowledge receipt of all amendments. To give bidders reasonable time in which to take an amendment into account in their Proposals ITI may, if the amendment is substantial, extend the deadline for the submission of Proposals.
6	Amendment to Bid	At any time prior to the deadline for submission of bids, the bidder may, for any reason, whether at its own initiative, or in response to a clarification requested by a prospective Bidder, submit the Revised Financial Bid.
7	Modification and Withdrawal of Bid	No bid may be withdrawn or modified in the interval between the bid submission deadline and the expiration of the bid validity period specified in Bid documents. Modification or Withdrawal of a bid during this interval will result in the forfeiture of its bid security.
8	Validity of Offer	The offer should be valid for a minimum period of 270 days from the date of submission. The Bids valid for a period shorter than specified period shall be rejected.
9	Prices	The prices quoted by the Bidder shall be FIRM during the performance of the contract and not subject to variation on any account. A bid submitted with an adjustable price quotation will be treated as non-responsive and

		rejected.
10	Deviation Clause	No Deviation from Specifications, Terms & Conditions of the tender is allowed. Quotations having deviation from our specifications, standard terms & conditions would be liable to be rejected.
11	Taxes and duties	The taxes and duties are to be clearly mentioned, if any.
12	Delivery schedule	As per the customer delivery schedule.
14	Payment Terms	a) Back to Back basis
15	Warranty / Annual Maintenance Contract (AMC)	As per Customer requirement.
16	Liquidated Damages (LD)	Liquidated Damages and Penalty shall be levied on back- to-back basis i.e. ITI shall deduct from the payment on amount equal to the LD levied on ITI by the end customer.
17	Training	Sensitization of Departmental staff on the project, fully training on use of the Digital Platform and applications. Training trainers within individual Departments that can help internal users develop workflows and user interfaces as per requirements.
18	Acceptance Test Procedure (ATP)	a) Vendor have to conduct the Acceptance Test (AT) before handing over of the project(s) to ITI project executing division. b) End Customer will perform testing.
19	Damage to Properties	In case of any accident/damage to customer/end user properties by the vendor, full responsibility will be attributed to the vendor.
20	Contractual Period	ITI's Delivery date provided to ITI by customer. Delivery extension will be on back-to-back basis. The successful Bidder shall so organize his resources and perform his work as to complete it not later than the date agreed to.

21	Extension of Contract	On back-to-back basis.
22	Inspection Authority	End Customer
23	Tender Award Criteria	Bidder Technical and Financial capabilities will be evaluated by a committee nominated comprising of internal stake holders of ITI Limited. The bidder offering best quality product with the handsome pricing shall be declared as the successful L1 bidder and the work shall be awarded to the successful declared (L1) bidder.
24	Tender Document Cost and Earnest Money Deposit (EMD)	<p>In case of bid submission: Tender Document Cost (Nonrefundable) and Earnest Money Deposit (EMD) (If Applicable) must be remitted through NEFT/RTGS/Net Banking. No interest shall be payable on the EMD.</p> <p>The Bank Details of ITI Limited for NEFT/RTGS/Net Banking is as below: Online RTGS/ NEFT Bank: Bank of Baroda, KG Marg MICR: 110012021 IFSC: BARB0CURZON Acc. No.: 06230500000010</p>
25	Performance Security Deposit	The value of performance security shall be 3% of contract value (issued to Business Associate/SIA by ITI) or end-customer's performance security (as per order to ITI) whichever is lower.
26	Consortium Bidding	Not Allowed.
27	Signing of the Bids	The Bid must contain the name, residence and place of business of the person or persons making the Bid and having Power of Attorney and must be signed & submitted by the Bidder with his usual signatures. Satisfactory evidence of authority of the person signing the bid on behalf of the Bidder shall be furnished on non-judicial stamp paper of an appropriate value with the Bid in the form of a Power of Attorney, duly notarized by a Notary Public , indicating that the person(s) signing the bid have the authority to sign the bid and that the bid is binding upon the Bidder during the full period of its validity. All the pages of Bid document and supporting documents must be signed and stamped by the authorized signatory having Power of Attorney. Any interlineations, erasures or overwriting shall only be valid if they are initialed by the signatory (ies) to the bid.

28	Submission of Tender	The ‘ Technical Bid ’ and ‘ Commercial Bids ’ shall be submitted in ITI Limited Tender Wizard Portal
29	Opening of Tender	<p>Technical bid will be opened on due date of tender opening.</p> <p>Note 1: The bidders or their authorized representatives may also be present during the opening of the Technical Bid, if they desire so, at their own expenses.</p> <p>Note 2: The technical bids will be opened and evaluated by a duly constituted committee. After evaluation of the technical bid, Price bids of only those bidders will be opened whose technical bids are found suitable. Date and time of opening of price bids will be decided after technical bids have been evaluated by the committee and will be intimated to technically qualified bidders.</p>
30	Rejection of Bid	ITI reserves the right to reject any or all tenders/quotations/bids received or accept any or all tenders/quotation/bids wholly or in part. Further, ITI reserves the right to order a lesser quantity without assigning any reason(s) thereof. ITI also reserves the right to cancel any order placed on basis of this tender in case of strike, accident or any other unforeseen contingencies causing stoppage of production at ITI or to modify the order without liability for any compensation.
31	Termination For Default	<p>ITI may terminate the contract in whole or in part for the following reasons:</p> <ul style="list-style-type: none"> • If the bidder fails to deliver any or all of the goods/services within the period(s) specified in the contract/purchase order, or within the extension time granted by ITI. • If the bidder fails to perform any other obligation(s) under the contract/purchase order. • If the bidder has engaged in corrupt/fraudulent practices in completing/executing the work assigned to him. • ITI may, without prejudice to any other right or remedy available to it, by a three days’ notice in writing, can terminate the contract as a whole or in part in default of the contract. ITI shall have the right to carry out the incomplete work by any means at the risk and cost of the bidder. • In addition to rights to forfeiture of PBG and application of LD charges, on the cancellation of the contract in full or in part, ITI shall determine what amount, if any, is recoverable from the contractor for completion of the work or part of the works or in case the works or part of works is not to be completed, the loss or damage suffered by ITI. In determining the amount, credit shall be given to the contractor for the value of the work executed by him up to the time of cancellation, the value of contractor’s material taken over and incorporated in work assigned as per the purchase order. • “Corrupt practices” means the offering, giving, receiving or soliciting of anything of value to influence the action of public official in the procurement process or in contract execution.

		<p>“Fraudulent practices” a misinterpretation of facts in order to influence the action of a public official in the procurement process or in contract execution and includes collusive bidding among bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels to hamper free and open competition.</p>
32	Force Majeure	<p>Neither party shall bear responsibility for the complete or partial non- performance of any of its obligations, if the non-performance results from such Force Majeure circumstances i.e. Flood, Fire, Earth Quake, Epidemic and other acts of God as well as War, Military Operation, Blockade, Act or Actions of State Authorities that have arisen after signing of the present contract. Party invoking this clause shall serve notice of seven days along with the proof of occurrence of the force majeure event to the opposite party. At the time of cessation of such force majeure event a notice of the same shall also be served to the opposite party.</p> <p>In such circumstances, upon a written approval of ITI, the time stipulated for the performance of an obligation under the present contract will stand extended correspondingly for the period of time of action of these circumstances and their consequences. However, any such extension shall be given only if extension is granted by the ultimate buyer/ user.</p> <p>Parties at all times take reasonable steps within their respective powers and consistent with good operation practices (but without incurring unreasonable additional costs) to:</p> <ul style="list-style-type: none"> a) Prevent Force Majeure Events affecting the performance of the Company’s obligations under this agreement; b) Mitigate the effect of any Force Majeure Event; and c) Comply with its obligations under this agreement. d) Further if the period of Force Majeure event extends beyond three months the parties may consider the fore closure of the agreement. <p>* Period of three months may vary at the discretion of ITI as per the validity period of the contract.</p>

33	Arbitration	All disputes arising out of this contract shall be referred to the sole arbitration of MSP Head, ITI Limited, Delhi or his nominee as per the Provisions of Indian Arbitration and Reconciliation Act 1996. Decision of arbitrator shall be final and binding on both the parties.
34	Jurisdiction	This contract between the supplier and buyer shall be governed by the laws of India and this contract shall be taken up by the parties for Settlement and orders only in Delhi jurisdiction.
35	Other Terms and Conditions	
i.		The Bidder(s) are required not to impose their own terms and conditions to the bid and if submitted, it will not be considered as forming part of their bids. The decision of ITI shall be final, conclusive and binding on the Bidder(s). In a nutshell, the Conditional Bid or Bid with deviations will be summarily rejected.
ii.		The Bids/Offer of the Qualified bidders (who qualify the eligibility conditions) only would be subjected to the technical-evaluation.
iii.		The bidder is expected to go through the Scope of work and Specifications. The bidders are to quote only fully compliant solution.
iv.		The exact strategy to address and win the business opportunity would be shared / discussed with the Best-Rated qualified bidder in due course of time.
v.		The bidder is required to extend the requisite support during the evaluation by giving Technical Presentation / Demonstration / Arranging site visits (if required) on "No-Cost No-commitment" basis.
vi.		Any clarification issued by ITI in response to query raised by prospective bidders shall form an integral part of bid documents and it shall amount to an amendment of relevant clauses of the bid documents.
vii.		A clause-by-clause compliance statement to all Sections of the EoI/RFP/Tender document is to be submitted in the Technical Bid, demonstrating substantial responsiveness. A bid without clause-by-clause compliance statement to Eligibility Criteria of the EoI/RFP/Tender document, shall not be considered for evaluation and shall be summarily rejected.
viii.		The bidder should study carefully the document to assess the work and Risk factors associated with such type of Business opportunities.
ix.		The bidder has to consider the following major Cost Factors while arriving at a commercial decision: <ul style="list-style-type: none"> • Direct Cost (requisite IT Hardware and Application Software) • Fiscal Cost • Logistic-Cost • Taxes/ Duties • Services and Administrative Cost • Training and Documentation Cost • Contingencies
x.		The bidder should enclose the documents in their ' Technical Bid ' & ' Commercial Bid ' as specified in the tender documents.
xi.		Please note that if any document/authorization letter/testimonies are found fabricated /false/ fake, the bid will be declared as disqualified and EMD will be forfeited. This may also lead to the black-listing of the bidder.

xii.		All the required documents to establish the bidder's eligibility criteria should be enclosed with the original bid/offer (Technical-Bid) itself. The EoI/RFP/Tender will be evaluated on the basis of the documents enclosed with the original bid/offer only. ITI will not enter into any correspondence with the bidder to get these certificates/ document subsequently. However, it reserves its right to get them validated/verified at its own.
xiii.		Due to any breach of any condition by the bidder, the Bid Security (EMD) if any submitted by the bidder may be forfeited at any stage whenever it is noticed and ITI will not pay any damage to the bidder or the concerned person. The bidder or/and the person will also be debarred for further Participation in future EoI/RFP/Tenders.
xiv.		All suppliers (including small scale units who are registered with the National Small Scale Industries Corporation under Single point registration scheme) shall furnish Bid Security to the purchaser as per the requirement. As such no bidder is exempted to furnish the EMD.
xv.		The training shall be given to the end customer to ensure trouble free operations of the System/Equipment.
xvi.		The bidder is required to enclose Notarized Copy of the Power of Attorney from its Directors/Top management which should indicate clearly the name of the signatory and title. The Bidders must ensure that all the documents are sealed and signed by authorized signatory.
xvii.		The Power of Attorney given to the Authorized Signatory should be submitted and executed on the non-judicial stamp paper of appropriate value as prevailing in the respective states(s) and the same be attested by a Notary public or registered before Sub-Registrar of the states(s) concerned.
viii.		Sealed offer/bid prepared in accordance with the procedures enumerated above should be submitted to the Tenderer not later than the date and time laid down, at the specified address.
xix.		ITI shall not be responsible for any postal delay about non-receipt / non- delivery of the bid/documents. This EoI/RFP/Tender Document is absolutely not transferable.
xx.		The bid submitted may be withdrawn or resubmitted before the expiry of the last date of submission by making a request in writing to ITI to this effect. No bidder shall be allowed to withdraw the bid after the deadline for submission of the EoI/RFP/Tender. In case of withdrawal after deadline of submission, EMD will be forfeited.

Special Terms and Conditions of RFP/EoI/Tender:

1. The requirement is meant for addressing a business opportunity which has emerged from some Govt. body.
2. The broad 'Scope of Work' would be as per the EoI/RFP/Tender Document. However, the exact Scope of Work will be intimated to the selected SI/Vendor in due course of time (once bidder is short-listed) for addressing the opportunity.
3. The bidder is supposed to address the business opportunity jointly with ITI under "Sole Investment Business Model". This may include arranging Bid Security and Performance Bank guarantee etc. All 'Terms and Conditions' as per ITI's customer with regard to Payment / Reward / Delivery/Penalty shall be applicable on the selected Business Associate /SI also (in the event of the award of the business to ITI by the end-customer).
4. The bidder must be prepared to work with ITI limited on exclusive basis and will neither submit any direct proposal (to the end-client) nor submit any business proposal (to the end-client) through other business partner/PSU. In case of violation of the same, the EMD (if any) shall be forfeited and the bidder will be black-listed.
5. Consortium bidding is not allowed for this EoI/RFP/Tender.
6. All activities like Proof of concept on "No Cost No Commitment" (NCNC) basis wherever applicable will be the responsibility of agencies.
7. Agencies should be willing to sign an exclusive agreement with ITI for smooth execution of the project.
8. Earnest Money Deposit (EMD) / Bid security required for submitting the bid will be borne by the selected agency.
9. All CVC circulars/ statutory guidelines as applicable needs to be followed.

EoI/RFP/Tender Rejection Criteria:

The EoI/RFP/Tender/Bid will be rejected in case any one or more of the following conditions are observed:

1. Bids received without Proof of Purchase of EoI/RFP/Tender Document (if any) and EMD as per requirement.
2. Bids which are not substantially responsive to the Invitation for EoI/RFP/Tender.
3. Incomplete or conditional EoI/RFP/Tender that does not fulfill all or any of the conditions as specified in this document.
4. Inconsistencies in the information submitted.
5. Misrepresentations in the bid proposal or any supporting documentation.
6. Bid proposal received after the last date and time specified in this document.
7. Unsigned bids, bids signed by unauthorized person (without a valid Power of Attorney).
8. Bids containing erasures or overwriting except as necessary to correct errors made by the Bidder, in which case such corrections shall be authenticated by the person(s) signing the bid.
9. Bid shall remain valid for the specified period from the date of opening of EoI/RFP/Tender prescribed by the purchaser. A bid valid for a shorter period shall be rejected by the purchaser being non-responsive.

Please Note

The business associate submitting the bid against this EoI/RFP/Tender must not have an alliance with other bidders / competitors of ITI for the same business opportunity. The bidder if selected as vendor/SI will not be allowed to address the opportunity directly/ extend the help to any other competitor of ITI Limited for the subject project.

Lowest-Bid (Best Qualified Bid) Evaluation Methodology:

1. This EoI/RFP/Tender would be subjected to a Two Stage (Technical & Commercial) Evaluation Process. All the Bidders are requested to note the entire evaluation process carefully.
 2. Prior to the detailed evaluation, ITI will determine the substantial responsiveness of each Bid to the EoI/RFP/Tender Document. For the purpose of ascertaining the eligibility,
 3. A substantially responsive bid is one which confirms to all the terms and conditions of the EoI/RFP/Tender Document without deviations.
 4. The purchaser's determination of bid's responsiveness shall be based on the contents of the bid itself without recourse to extrinsic evidence.
 5. ITI may waive any minor infirmity or non-conformity or irregularity in the bid which doesn't constitute a material deviation, provided such waiver doesn't prejudice or effect the relative ranking of any bidder. The bids submitted by the Bidders would be subjected to a well-defined and transparent evaluation process.
 6. The Bids would be evaluated by a duly constituted Committee of ITI Limited, whose decision would be generally taken as final, unless the aggrieved party establishes any Prima facie errors in the findings of the Committee. In such a situation, he may file a representation within 3 working days of receipt of decision from ITI Limited, duly listing the reasons / grounds. Such a representation would be considered at Senior Management Level of the Tendering Authority, whose decision would be final and binding on all the bidders.
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1. The Bidders who have submitted the EoI/RFP/Tender Document cost & EMD will be considered for Technical Evaluation.
 2. In Technical Evaluation process, all the Technical Bids of the preliminary eligible bidders (as mentioned above) would be scrutinized thoroughly w.r.t. our EoI/RFP/Tender Document. The Bidders, who will qualify in the Technical Evaluation process, would be considered for Commercial Evaluation.
 3. In Commercial Evaluation process, all the Commercial Bids of the technically qualified bidders (as mentioned above) would be scrutinized thoroughly w.r.t. our EoI/RFP/Tender Document.

4. The evaluation of technical and commercial marks will be normalized and then 60% weightage will be given to technical evaluation and 40% weightage will be given to financial evaluation in order to calculate a comprehensive mark.
5. Formulae for Evaluation is as mentioned below:
6. Bid Evaluation

First and Second Stage Bid Evaluation

All EoIs (bids) would be subjected to a process where the weightage of the technical part would be 60% and the weightage of the Commercial/Financial part would be 40%.

TECHNICAL RATING (**TR**) would be evaluated on the basis of the following formula:

$$\mathbf{TR} = \frac{60}{100} \times \mathbf{Technical\ Score\ (TS)}$$

Where Technical Score (**TS**) would be calculated as per the committee marks.

Vendor should have at least 650 Technical Score out of 1000 to become eligible for opening of commercial bid.

COMMERCIAL RATING (**CR**) would be evaluated on the basis of the following formula:

$$\mathbf{CR} = \frac{40}{100} \times \mathbf{Commercial\ Score\ (CS)}$$

COMMERCIAL SCORE (CS) will be worked out as formulae given below

A= Cost for Operation and Maintenance, and expansion of physical and IT infrastructure for State Government Data Center

B= Margin (in Percentage)

C= (A*B)/100

D= A-C

$$\mathbf{CS} = \frac{\mathbf{D\ of\ the\ Lowest\ Bidder's\ Quote\ (LQ)}}{\mathbf{D\ of\ the\ Actual\ Bidder's\ Quote\ (AQ)}} \times \mathbf{1000}$$

$$\mathbf{VR\ (Vendor\ Rating)} = \mathbf{TR\ (Technical\ Rating)} + \mathbf{CR\ (Commercial\ Rating)}$$

The Bidder with highest VR will be treated as best bid.

7. ITI reserves the right to reject any or all bids without assigning any reasons thereof. ***It shall not be obligatory for ITI to award the work only to the lowest bidder.***

Documents to be submitted along with the “Technical Bid”:

The Bidder/System Integrator (SI) must submit the following documents along with their Technical Bid:

- Bid covering Letter on the Letter-Head of the Bidder Company indicating Name and Address of the Authorized Signatory (with Contact telephone numbers and email ID) as per Annexure-A.
- Bidder's Profile.
- Proof of Empanelment with ITI.
- Case-Specific Power of Attorney authorizing the bidder to submit the Bid/EoI on behalf of the Bidder/Consortium.
- Tender-Document Cost (if any) of required amount.
- Bid Security declaration as per Annexure - G.
- Copy of PAN Card.
- Insolvency certificate
- Detailed Methodology
- GST Registration Certificate.
- Turnover Certificate(s)/Audited Balance-sheet(s) & Profit-Loss Account(s) of the Bidder for last three years.
- Declaration on the Letter-Head of the Bidder Company for Non-Black Listing as per Annexure
- Declaration / Undertaking on the Letter-Head of the Bidder Company as per Annexure(s).
- Compliance Statement of 'Eligibility Criteria of the Bidder' along with supporting documents (credentials, experience certificates, declarations & others)
- Integrity Pact /Non-Disclosure Agreement as per Annexure
- Tender Documents duly signed & accepted by the bidder
- All necessary MAF, Technical Literature, Data Sheets and other documents

In case, the bidders do not submit any of the above mentioned papers/information along with Expression of Interest, his bid will be rejected and bid will not be considered for further evaluation.

It is reiterated that any bid not fulfilling any of the essential requirements mentioned in this EoI/RFP/Tender document would be classified as “Technically Non-Qualified/Non-Responsive” and Commercial bids of such bidders will not be opened and subsequently returned to the bidder. ***No relaxation would be given to any bidder on any of these conditions.***

Documents to be submitted along with the “Commercial Bid”:

The Bidder/System Integrator (SI) must submit the following documents along with their Commercial Bid:

1. Price Bid as per EoI/RFP/Tender Document format only. No other format will be accepted.

1 Scope of Work

The “Bidder” hereafter may be called as “Contractor” shall conduct the field survey, preparation of design drawings and supply of CITS project equipment and materials, spare parts, test equipment, tools and materials, factory inspection (inspection of equipment & materials upon delivery), training, transportation and site delivery, construction and installation, preparation of as-built drawings, testing, commissioning, spare parts management and Comprehensive operation and maintenance and manpower of the CITS project.

The Contractor shall undertake the works that are not specifically mentioned in the Employer’s Requirements but essential for the efficient operation of TIMS and CBS.

The requirements stated herein is to be construed as minimum requirement and meeting the respective requirements shall not relieve the Contractor from the responsibility of installing the integrated system that functions efficiently and also carry out its comprehensive Operation & Maintenance.

The scope of the project consists of the software, equipment, materials, cables, Communication, Power requirement, Civil Works, safety, Quality and facilities to be implemented by the CITS Project called “the System”. The System consists of (1) Traffic Information & Management System (TIMS) which consists of seven (7) subsystems and (2) City Bus System (CBS) which consists of three (3) subsystems and (3) related civil works. The construction of equipment pole and gantry, handhole, conduit, tunneling mechanical duct boring, road marking, intersection improvement, temporary restoration of paved road, final reinstatement of road and sidewalk, Safety and etc. on Full Turnkey basis by the Contractor.

The configuration of the System is shown in the Table 2-1.

Table 2-1: Configuration of the System

No.	Type	Name	Quantity
1.	Component	Traffic Information & Management System (TIMS)	
1-1.	Subsystem	Adaptive Traffic Signal Control System (ATCS)	165 Junctions

1-2.	Subsystem	Traffic Incident Detection System (TIDS)	58 Junctions
1-3.	Subsystem	Variable Message Sign System (VMS)	17 Locations
1-4.	Subsystem	Speed Limit Violation System (SLVD)	10 Locations (11 units)
1-5.	Subsystem	Red Light Violation Detection System (RLVD)	50 Locations
1-6.	Subsystem	Automatic Traffic Counter and Classifier (ATCC)	230 Units
1-7.	Subsystem	Integrated Traffic Management System (ITMS) with probe system Platform and with required integrations	1 Location
2.	Component	City Bus System (CBS)	
2-1.	Subsystem	Bus Monitoring System (BMS) including Computer Aided Dispatch / Automatic Vehicle Location (CAD/AVL) system	3500 Buses
2-2.	Subsystem	Passenger Information System (PIS)	71 Terminals and 532 Bus shelters
2-3.	Subsystem	Depot Management System (DMS)	31 Depots

There are two (2) Command Control Centre (CCC) shall be established for the operation of TIMS and CBS under the CITS Project.

- One is for TIMS Command & Control Centre (TIMS-CCC) which will be established with Chennai Traffic Police. All necessary facilities, equipment and associated works which will make TIMS-CCC functional shall be undertaken by the Contractor.
- Second is CBS Command Control Centre (CBS-CCC) which will be established with the Metropolitan Transport Corporation. All necessary facilities, equipment and associated works which will make CBS-CCC functional shall be undertaken by the Contractor.

The Contractor shall also do the Intersection Improvement works at 165 intersections specified here in the Employer's Requirements.

The scope of work shall include but will not be limited to the following broad areas:

1. Assessment, Scoping and Survey Study: Conduct a detailed assessment, survey, gap analysis, scoping study and develop a comprehensive project plan, including:
 - a) Assess existing systems, street infrastructure and connectivity within the city and the greenfield site for the scope items mentioned in this Volume of the RFP
 - b) Conduct site survey for finalization of detailed technical architecture, gap analysis, final Bill of Materials, and Project Implementation Plan
 - c) Conduct site surveys to identify the need for site preparation activities
 - d) Obtain site clearance obligations & other relevant permissions with the support of the Employer.
2. Design, Supply, Installation, Testing and Commissioning of the following primary components:
 - a) Two Command Control & Communication Centre
 - b) Data Centre within CTP & MTC Buildings or cloud-based primary data center
 - c) Cloud Data Centre for DR (Hosted in data center of any MEITY empaneled Cloud Service Provider)
 - d) Traffic Information Management System (TIMS)
 - Adaptive Traffic Signal Control System (ATCS)
 - Automatic Traffic Counters-cum-classifier (ATCC) System
 - Red Light Violation Detection (RLVD) System
 - Speed Limit Violation Detection (SLVD) System
 - Traffic Incident Detection (TID) System
 - Variable Message Sign (VMS) board
 - Integrated Traffic Management System (ITMS) with Probe System Platform with required integrations
 - Call Center
 - Intersection Improvements

- e) City Bus System (CBS)
 - Bus Monitoring System (BMS) including Computer Aided Dispatch / Automatic Vehicle Location (CAD/AVL) system
 - Passenger Information System (PIS)
 - Depot Management System (DMS)
- f) Web Portal & Mobile App

The minimum requirements of the above are delineated within the subsequent sections.

3. Data Centre: Provisioning of Hardware, Network and Software Infrastructure which includes design, supply, installation and commissioning of Information and Communication Technology Infrastructure at the Command Control Centre; including Data Centre. This scope consists of:

- a) Site preparation services
- b) IT Infrastructure including server, storage, other required hardware, application portfolio, licenses
- c) Command Control Centre infrastructure including operator Video Walls, workstations, IP phones, joystick controller etc.
- d) Establishment of LAN and WAN connectivity at command center and DC limited to scope of infrastructure procured for the project
- e) Data Exchange services among different projects with the CMA
- f) Application integration services with the above identified applications

4. Provisioning of Network Infrastructure within the Roadside Equipment and Control Center

- a) Provisioning of network infrastructure on fiber optic underground cable, Wireless, 3G/4G/or upcoming 5G as defined in this document etc.
 - 1. Between field devices (ATCS, Cameras, VMS, all field ITS equipment etc.) & Data Centre
 - 2. Between CBS Command Control Centre & TIMS Command Control Centre
 - 3. Between server room, Data Center & viewing/monitoring center etc.
- b) Connectivity between DC & proposed DR
- c) Integration with existing project control center at data level.
- d) Internet Connectivity at DC in control center
- e) Network shall be sized with enough capacity to support the redundancy and future traffic growth in order to complete traffic rerouting on the network in event of failure without impacting overall network performance.
- f) The Right of Way (RoW) charges (If any) shall be borne by the Contractor and necessary approval shall be taken prior to commencement of the work.
 - 1. RoW will relate to the project roads including NH, SH and all other major and minor roads within the CMA subject to technical feasibility.
 - 2. The work will be carried as per the road cut specifications specified by GCC/HMPD/NHAI. Reinstatement (RI) charges/ Restoration Charges along with other fees have to be borne by the Contractor.
 - 3. Once the RoW work is finished satisfactorily, the ROW application Permission Fees pertaining to GCC shall be reimbursed by the Employer.(The cost of Road restoration charges is not included in this)

5. Commissioning, Trial Operation, Training and Capacity Building for the Employer and any other department which includes preparation of operational manuals, training documents and capacity building support, including:

- a) Pre-Commissioning and Commissioning Test of the system
 - b) Trial operation after Commissioning test on Completion
 - c) Training & Capacity Building of authorities, operators, and other stakeholders on operationalization of the system
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- d) Support during execution of acceptance testing
 - e) Preparation and implementation of the information security policy, including policies on backup and redundancy plan
 - f) Preparation of revised KPIs for performance monitoring of various ITS utilities monitored through the system envisaged to be implemented
 - g) Developing standard operating procedures for operations management and other services to be rendered by the Contractor
 - h) Preparation of system documents, user manuals, performance manuals, Operation manual etc.

6. Comprehensive Operations and Maintenance

The Contractor shall undertake the Comprehensive O&M Service of the System for a period of five (5) years (1,825 days) from the date of the Taking-Over Certificate by component including 24 Months (730 days) of Defects Notification Period. Except otherwise specified in the Employer's Requirements, it is the Contractor's responsibility to provide sufficient organization and manpower to implement flawless O&M Service of the System in operation in the manner originally intended. The comprehensive O&M services include the Power Supply, Last mile Connectivity, Communication charges, Manpower, consumables, Maintenance vehicle etc.

The Contractor shall promptly notify the Employer and the Engineer of any error, omission, fault or any other defect in the design of or Employer's Requirements for the Works which he discovers when reviewing the Contract Documents or in the process of execution of the Works or during the Operation & Maintenance Phase.

The Contractor shall quote for the entire system and facilities on a "single responsibility" basis such that the Contract Price covers all Contractor's obligations mentioned in or to be reasonably inferred from the Contract Documents in respect of the design, manufacture, procurement, construction, installation, adjustment and testing of the works and remedying any defect therein. This includes all requirements under the Contractor's responsibilities for testing and commissioning of the systems and facilities, and where required by the Contract Documents, the acquisition of all permits, approvals and license, etc.; the training services and such other items and services as may be specified in the Contract Documents

Section VII

Technical

Requirements Chapter 1

General Design

Requirements

1 General

The Contractor shall undertake the site survey and prepare detailed design of Traffic Management & Information System (TIMS) and City Bus System (CBS) and associated facilities and works, hereinafter collectively referred to as the CITS Project system. The CITS Project System shall meet all the design criteria stipulated in the Employer's Requirements.

All systems to be installed under this Contract shall be capable of continuous, unattended, 24 hours a day, 7 days a week operation under the environmental conditions prevailing in the Chennai. Should the design require periodic replacement of any equipment or component, the replacement schedules of such equipment or component shall be described in the Technical Proposal and in the maintenance manual.

2 Detailed Design

2.1 Design Briefing

Within 30 days after the effective date of contract, the Contractor shall conduct a design briefing session in India. The design briefing shall cover all the system components and civil works included in the Contract. The main objective of the briefing is to acquaint the Employer with the design concept and outlines of the proposed systems, and to allow them to examine whether or not the Contractor's design complies with the Contract.

2.2 Design Review and Approval

Within five (5) months after the effective date of contract, the Contractor shall submit a System Detailed Design to the Employer for his review and approval. The System Detailed Design shall provide detailed information of the proposed system, including system configuration, block diagrams, input and output, flow charts, interface, design calculation and manufacturer's specification sheets for all systems and shall cover all necessary hardware, software, database and operating procedures.

The Contractor shall submit System Detailed Design for each component system as it is completed and shall not leave until all components have been designed to expedite the project implementation. If design change is necessary for the portion of the detailed design that has been submitted and approved due to the design of other portions, revised detailed design shall be submitted with the modification noted for approval.

The Contractor shall not, without specific approval in writing by the Employer, place any material, part or component on order, nor commence manufacturing of any equipment or software coding until the System Detailed Design has been approved by the Employer. The Contractor shall not implement any changes on the approved system design without prior approval of the Employer.

The approval of the System Detailed Design by the Employer, however, does not relieve the Contractor from delivering a fully operational and reliable system.

2.3 Hardware System Design

Hardware portion of the System Detailed Design shall include among others the following:

- Functional and physical system block diagram of each component system
- Connection and interface between the blocks in the block diagram
- Functions, capacity, input, output, and method of operation

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- Response time, delay, allowance, attenuation, loss and other figures as appropriate for applicable equipment
 - Environmental and physical design specifications of the equipment. Manufacturer's product specification sheets may be accepted for standard products
 - Power consumption of each equipment
 - Cable network diagram
 - Cable work plane plan
 - Conduit line plan
 - Equipment layout in the Command-and-Control Centre of Chennai Traffic Management & Information System and the Command-and-Control Centre of City Bus System
 - Equipment layout, interior and lighting plan in the Command-and-Control Centre of City Bus System
 - Manner of installation

2.4 Software System Design

Software portion of the System Detailed Design shall include, as a minimum, description of module, identification of tasks, priority level, execution schedule, input and output, algorithms and parameters, database structure and contents, parameter update procedures, data flow, calling sequences, error detection, backup and recovery and programming languages.

Structure of software shall be simple and straightforward. Interdependency and interaction between modules shall be clear and kept to minimum to prevent defect in one module from affecting many modules. Data and parameters shall be separate from the program and kept in the database.

2.5 Operating Procedures

Operating procedures for all the device and equipment of the System shall be identified and described in detail in the System Detailed Design. Frequently used operating sequences shall be described in a step-by-step manner.

Fool proof mechanism shall be incorporated in the operation procedure to prevent any inadvertent mistake to cause serious damage to the system, operation and safety.

2.6 Design Standard

All equipment the Contractor supplies shall be new and subject to the Tests on Completion to the satisfaction of the Engineer. Unless other standards are specifically required to be complied with herein or in the Contract, all materials and components used under the Contract and all design calculations and tests shall be performed in accordance with the Indian Standard and standards provided by the Indian Road Congress (IRC).

In the absence of such standards in India, relevant clauses of international standards including but not limited to International Electrotechnical Commission (IEC), Institute of Electrical and Electronic Engineers (IEEE), International Organization for Standardization (ISO), International Telecommunication Union Telecommunication Standardization Sector (ITU-T) and International Residential Code shall be applied.

In the absence of such standards in India and in the international standards mentioned above, industry standards generally accepted and approved in one of the major industrialized countries such as Great Britain, Japan, U.S.A, and Germany shall be applied.

If the Contractor offers materials, equipment, design calculations or tests which conform to the standards other than those specified standards, full details of the differences between the

proposed standard and the specified standards shall be submitted when required by the Engineer.

3 Design Life

All components and materials used in this Contract, excluding consumable items such as lamps, shall be of a design life of 10 years or longer, used for the System, and unless specifically stated otherwise in the System Specifications. The Employer may approve components with a shorter design life if they are easily replaceable and a 10-year design life is generally considered infeasible or uneconomical. The replacement of such equipment shall be possible without displacing other component.

4 System Configuration

The Contractor may adopt a system configuration as long as the functionality and performance of the system meet the system requirements specified herein. It is the Contractor's obligation to show that the proposed system will satisfy all the requirements in the system specifications.

4.1 System Network

It is required that the Centre server system employs an open network architecture consisting of several servers, operator consoles and central controllers connected through a standard local area network based on TCP/IP. To ensure a high level of reliability and operational flexibility, it is required that the operator console connected to the network shall complement each other and shall not be dedicated to a specific function. Breakdown of an operator console shall not affect the normal operation of the system in any aspect. Database server shall have a redundant configuration of RAID system or similar highly reliable configuration.

4.2 Component Systems

The CITS Project to be constructed under this project composes of many component systems as described in this RFP. Some of them are closely integrated with other systems, while others are standalone system with no data exchange with other systems. All of them shall be designed with a consistent design policy and concept to achieve the overall objectives of the total system.

Functional and performance requirements for each component system are defined in these specifications. The Bidder shall undertake the detailed design of each system in such a way that the total system is efficient, reliable and user friendly in operation. The system design shall incorporate the latest technology in each field but propriety technology available from a single vendor only shall be avoided.

All CITS Project equipment shall work 24 hours a day on all days of the year and all field equipment shall be fully suitable for outdoor operations under adverse weather conditions.

All type of cameras shall support ONVIF profile S/G and shall be FCC Class A, UL, CE, BIS certified. The cameras shall be provided with minimum 128GB internal/local storage (Class 10 or better SD card).

All Servers, Storage, Computing, LPU, Networking, Security devices etc. shall be BIS certified.

The MAC (Machine Authentication Code) address of all the equipment shall only be registered in the OEM's name.

All modules except ATMS CPS application shall be third-party COTS (Commercially available off-the- shelf) enterprise edition software and only third-party COTS enterprises edition software shall be provided for the software/ solution/ application / module specified as COTS in the ToR/BOQ and no customised or proprietary software/ module of the Contractor shall be provided for applications such asNMS, VMS, GIS, etc., as approved by Engineer.

5 Reliability

Each type of CITS Project equipment shall be designed to operate continuously for a period of time as specified in the relevant section of this document, when used in the CITS project environment.

Generally, each item of CITS Project equipment shall have a Mean-Time-to-Repair (MTTR) (time to full normal operation following a failure) specified under required service levels in the associated Service Level Agreement contract. Equipment failure and MTTR metrics will be monitored and recorded through an exclusive CITS Project Enterprise Management system (EMS) that shall be continuously maintained for audit by Employer, Engineer or its authorized representative.

6 Digital transmission system

Digital transmission system for data exchange between field equipment and central equipment shall use IP based transmission system complying with the established international standards such as ITU and IEEE. All data transfer between the central equipment and the field equipment including video streaming and image shall be made in digital format except the section between local controller and the terminal device. Internet based and wireless transmission system shall also adopt digital form.

In addition, the CITS Project shall support communication with Internet of Things (IOT) equipment/systems utilizing the associated standard protocols like MQTT

7 CITS Project System

The CITS Project System shall have high reliability, accuracy, and security in design. Stoppage of the total system shall not be allowed under any circumstances. Redundant hardware configuration shall be adopted for key components to ensure continuous operation. Data backup mechanism shall be used to prevent data loss. Operation log shall be kept to allow tracing of operation in case of any dubious event. Mechanism shall be incorporated in the system design to prevent illegal or fraudulent activities by the Control room operators

8 Software

The Contractor shall provide a set of software to operate on the servers, workstations and computers of the System to be provided under the Contract. The software shall function as a system to provide end results required in the Technical Requirements.

The Contractor shall state details of the language to be used for the System in the Technical Proposal of the Tender. The copyright of the software specifically developed for the project shall remain with the Contractor.

The set of the software to be provided shall consist of those provided by third party and those specifically developed for the Project. All third-party software shall be legally licensed. They shall be registered under the name of Employer and any supports and services provided by the software developer including update and revision shall be available to the Employer.

The software to be specifically developed for the Project shall be fully tested and shall be free from bugs. The Contractor shall state in the Technical Proposal of the Tender the software quality assurance program that he intends to adopt in developing the software.

The programming of the applications shall be arranged in such a way that maximum flexibility is afforded by the design to allow the Employer to implement modifications or additional facilities which

may become available or desirable during the working life of the system. The Contractor shall implement minor modifications of the software such as improvement of human interface of the system etc. requested by the Employer in the trial operation period free of charge. After finishing the trial operation period future modifications or changes shall not be the part of the current scope of the contract and shall be estimated and paid time to time by the Employer if required.

The system shall be designed and deployed to achieve a high degree of manageability to ensure ease of configuration, maintenance, upgrades, troubleshooting, health monitoring, fault detections, remote monitoring, system administration and inventory management.

9 Diagnosis and Security function

9.1 Diagnosis Function

The system acts as a simple network management protocol (SNMP) agent that can generate an SNMP trap because of a rule activation of all equipment.

Also, each system has a diagnosis function. The centre server shall log the status of all equipment including field equipment by sending the diagnosis signal in every five (5) minutes. If fault signal is received or there is no response from the field equipment, the centre server should issue an alarm and the fault should be recorded in the log, which can be used for SLA calculation.

9.2 Security

The main features and data of the software shall be protected by multi-level password control to avoid intrusion of third-party. The system shall be operated only by the persons registered in advance. Unauthorized persons shall be rejected to access to the system to prevent the system as well as incorrect or dangerous traffic controls at the intersections.

Log on process shall be applied with the access control using password and log-on/log-off record shall be made. The Bidder shall propose the access control method in the technical proposal.

The Security design solution shall be based on the best industry practices and adhere to security standards such as ISO 27001

10 Data Policy

10.1 General Policy

The Contractor shall comply with the policy on Open Application Programming Interface (API) for GoI and Policy of Open standards and update time to time during the project period as per the Standard International/National norms.

10.2 Interoperability of Data

The traffic big data stored by the System will be useful in utilizing a transport or road planning not only for the Employer but also other related government agencies. It will be important that the traffic big data stored in the System will be able to be shared easily with such agencies in the future. The Contractor shall consider and implement the open standard data format for that purpose.

10.3 Interoperability of Equipment

The System may be expanded additionally installing the roadside equipment in the future. The Contractor shall consider international standards of the data format and the data communication method between the roadside equipment and the centre server to keep the interoperability of the roadside equipment.

11 Environmental Conditions

11.1 General

All equipment shall be designed to operate properly under the environmental conditions normally encountered at the site of the equipment in Chennai and shall conform to the minimum requirements specified herein.

11.2 Temperature and Humidity

Adequate protection from moisture condensation, fungus, rust, insects, rodents, and dust shall be provided. All equipment shall be adequately treated to prevent rust and corrosion due to high humidity or moisture condensation.

11.2.1 Indoor Equipment

Unless specified otherwise, indoor equipment shall be designed to operate in the temperature range of 0 to 35 degrees Celsius, and the relative humidity range of 5 to 85 percent.

11.2.2 Outdoor Equipment

Unless specified otherwise, outdoor equipment shall be designed to operate in the temperature range of -10 to 60 degrees Celsius, and the relative humidity range of 40 to 95 percent.

11.3 Wind

All outdoor equipment and their support, individually and fully assembled and installed as a whole, shall withstand an instantaneous wind velocity of at least 50 m/sec as per IS-875 part 3.

11.4 Degree of Protection Provided by Enclosures (IP)

The equipment and cabinet to be installed outdoor shall be electrically and mechanically isolated and shall have a degree of protection of IP65 or higher unless otherwise specified.

12 Power Supply

The input power supply of any equipment shall not be connected to any electric components except arresters without connecting first through fuses, power switches and circuit breakers.

All equipment shall be provided with a clearly visible label indicating the input power supply type (AC or DC) and voltage. All equipment shall operate with the power supply of 230V plus or minus 10 percent, and 50 hertz plus or minus 3 percent. All field equipment shall operate normally under instantaneous power supply interruption of 20 milli-second or shorter.

The power supply voltage available in the field will be 230V AC. Unless specified otherwise or with the approval of the Employer, all field equipment shall be designed to operate directly on 230 V AC. The Contractor shall be responsible for arranging the terminal devices necessary to receive the power supply.

System enclosures shall include a power distribution subsystem for supplying power to each component within the enclosure and related / inter-connected equipment. The circuit breakers shall be properly sized according to the expected loads of the concerned equipment and to meet relevant electrical code requirements.

All electrical equipment and cabling shall be provided in accordance with relevant BIS standards. In case there no relevant BIS standard exists the BS 7671 standard shall be applicable.

The power distribution panel shall be directly fed by the main circuit breaker at the electrical point of service. The power distribution assembly shall include an interface and connection to the UPS (where provided). The power assembly shall be connected to the earthing system.

The enclosure shall be earthed in accordance with the relevant BIS and NBC 2016 regulations. The enclosure shall include a 230Vac 15 Amps 3-pin dual socket power outlet conforming to BIS standard. The power sockets shall be installed in accordance with relevant BIS standard.

Surge Protection Devices (SPDs) shall be provided at main's entry level (LT Panel level / Entry panel – 230/400 V AC or at UPS level) for each external cable (related to power supply, signal, data or any other), connection which is terminated at any item of exposed external equipment or routed through an outdoor area at equipment location and building. The SPD shall be rated in accordance with IEC 61643-11 and NBC 2016 latest and valid standards. It shall be non-exhausting metal encapsulated, spark gap-based technology. The SPD shall be tested as per IEC 61643-11:2011 (or equivalent EN 61643-11:2012) from KEMA or VDE international independent test labs. The SPD shall be rated for 255 V. It shall be capable to discharge Lightning current (10/350 μ s) of 25 kA for L-N and 100 kA for N-E. The device shall have voltage protection level of device shall be ≤ 1.5 kV including inbuilt fuse. The SPD shall have current extinguishing capability [L-N]/[N-PE]: 100 kArms / 100 Arms. The device shall have followed current limitation/Selectivity resulting in no tripping of a 35 A gL/gG fuse up to 50 kArms. The device shall have built in fuse and operation of SPD shall be independent of Line current. No requirement of additional overcurrent protection. The device shall have mechanical indication-based health indication for L-N and N-PE SPD along with the common potential free contact / changeover contact for remote monitoring.

Network Surge Protection Device (SPD): The different components of system shall be installed with surge protection device in accordance with IS/IEC 62305-4, the selection/location shall be decided depending upon the criticality of the application. The communication interfaces shall be installed with suitable SPD. SPD for POE shall meet the latest standards and suitable SPD for 12VDC supply and 5VDC supply, as applicable and complying to IEC 61643-21 / EN 61643-21 shall be installed and shall be UL approved.

The Contractor shall perform all the necessary application procedures to the Power Company required for the power to be supplied to the CITS Project Scope. All the expenses charged by Power Companies regarding such applications shall be borne by the Contractor. The work to be undertaken by Power Companies up to the boundary of property and responsibility between the Employer and Power Companies, as well as the expenses incurred there from, shall be in the scope of this Contract.

Provision for Power supply and UPS (outdoor and Control Center) shall be provided at each location for field Equipment's and two Control Center locations. The Bidder shall present the calculation of power consumption and capacity of power supply system to be used for the under this contract. The Bidder shall also consider the power requirement of network devices, wireless access points, switch, etc. suitably during the calculation. Proper earthing shall be provided at each equipment location.

The type and the number of the Power supply, Electric Meter proposed by the Bidder as per the design shall be mentioned by the Bidder in the BOQ. The cost of the Power Supply devices and materials that is not explicitly listed in the BOQ of the Bid submitted by the Bidder or supplied by the Bidder during the installation works but deemed necessary for the system during any stage of this Contract shall be included in the cost of appropriate items and the Contract Price, and no separate payment shall be made.

13 Cabling and Wiring

- (a) The Contractor shall provide standardized cabling/wiring for all devices and subsystems.
- (b) The Contractor shall ensure the installation of all necessary cables and connectors between the field sensors /devices assembly, outstation junction box, for pole mounted field sensors/devices the

cables/wiring shall be routed down the inside of the pole and through underground duct to the outstation cabinet.

- (c) All cables/wirings shall be clearly labeled with indelible indications that can clearly be identified by maintenance personnel. The proposed cable/wiring shall meet the valid directives and standards.
- (d) Cabling/wiring must be carried out per relevant standards. All cabling/wiring shall be documented in a cable/wiring plan by the Contractor
- (e) The Contractor shall provide New Power Connection, Necessary cabling and Ducting, No overhead cabling will be allowed under this project. It is the responsibility of the Contractor to obtain permission from respective agency for scope of work under this project..
- (f) The cable and necessary arrangements proposed by the Bidder as per the design shall be mentioned by the Bidder in the detailed BOQ during detailed design. The cost of the Cabling and necessary arrangements that is not explicitly listed in the BOQ of the Bid submitted by the Bidder or supplied by the Bidder during the installation works but deemed necessary for the system during any stage of this Contract shall be included in the cost of appropriate items and the Contract Price, and no separate payment shall be made.

13.1 Cabling

13.1.1 Type of Cable

- (a) The Contractor shall provide all types of cable necessary for the System including but not limited to power cable, optical fibre cable, LAN cable, control cable, signal lantern cable, and grounding cable. The cables shall be of suitable type and rating for the use.
- (b) All underground cable shall be placed inside steel, polyvinyl chloride (PVC) or high-density polyethylene (HDPE) of suitable size and unless otherwise specified no direct burial cable shall be used.

13.1.2 Cable Installation

- (a) Test piece cable shall not be smaller in outer diameter than the cable to be installed shall be used for testing of ducts, whenever damage to cables could be foreseen or expected.
- (b) Duct cables shall be pulled into ducts with sufficiently friction free methods. The pulling tension shall be constantly checked so that the cable will be pulled within allowable pulling tension and this shall be specified by Contractor.
- (c) Splicing shall be carried out as soon as possible after placing of the cables.
- (d) Cable shall be always delivered to site with reeling on cable drums.
- (e) In every handhole, each cable shall be provided with the cable identification tags on which the cable type, size and gauge including the descriptions of interstitial metallic pairs, cable name, name in abbreviation, name of manufacturer and date of installation shall be written indelibly.

13.1.3 Aerial Cable Installation

- (a) The aerial cable shall be regularly suspended at 50 cm from the top of each pole. The minimum separations from power cable are shown in the table below.
- (b) Sags of aerial cable shall not exceed 0.8 m under the worst conditions expected.
- (c) Necessary safety measures shall be in the scope of the Contractor

Table 13-1: The Minimum Separation from Power Cable

Power Cable Voltage	Minimum Separation
Less than 600 Volts	60 cm
600 – 700 Volts	120 cm
7,000 – 15,000 Volts	200 cm

13.2 Wiring

13.2.1 Power Line Connection

Connect the power line on a terminal box or terminal stand, in principle.

13.2.2 Connection of Power Line and Equipment Terminals

Connect the power line and equipment terminals as follows.

- (a) “Screw-in terminals” : Sufficiently screw in the terminals.
- (b) “Snap-on terminals” : Thrust the terminals to the designated depth so that they do not come off.

13.2.3 Insulation Resistance

Insulation resistance value to aerial and underground wires should be $1\text{M}[\Omega]$ under the conditions of the equipment installed. However, leak current measuring can be substitutable, with the value of 15mA and lower.

13.2.4 Aerial Wiring Work

The holding height of aerial wires to the dedicated pole and others should be 6.0m and higher, in principle. Even for the lowest flexure point, it should be kept 5.1m and higher above ground level.

13.2.5 Holding Suspension Wires and Grounding

Suspension wires should be held without any looseness to their designated points or proximity of them with round simples and winding grips. The wires should be twisted once in every 10m .

13.2.6 Wiring between Poles

For wirings expect for self-support type cables, hang them on suspension wires using a lashing rod per 70cm distance.

13.2.7 Pull-down Wires to Roadside Equipment

When pulling down wirings for roadside equipment, connect them so that they do not touch the pole by drum insulators. The relay length of insulators should be 2m and lower.

13.2.8 Pull-down Wiring to Local Controller

- (a) When pulling down wires to Local Controller, for holding-in type, basically use continuous columns, and pull-down cables from the terminal box placed on the pole or those connected to aerial wires in the terminal box by passing them inside the pole, and then connect to the terminal inside an auxiliary case. If connecting them through an external rising pipe, pulling them down and connect with rising pipe of $\phi 50\text{ mm}$ or larger. The installing position of the terminal box.
- (b) Terminal boxes connecting aerial wires, pulled down wires for signal lamp equipment and those for Local Controller should be installed 5m and higher above ground level. Standards for Wire Tying. Apply wire tying to wires at service entrances of each lamp equipment, terminal boxes on the pole, the inside of Local Controller and other necessary positions.

13.2.9 Cable Protection

If cables are likely to be damaged by trees on a street and others, protect them by applying a cable protection cover etc.

13.2.10 Power Line Lead-in Work

Lead in the power service line with a dedicated pipe through a power connection box or an auxiliary case to Controller.

13.2.11 Dedicated Line Lead-in Work

Lead in a dedicated line with a duct through a dedicated line protection box or an auxiliary case to Local Controller. Do not connect them in the middle.

14 Grounding/Earthing

All electrical components are to be earthen by connecting two earth tapes from the frame of the component ring and will be connected via several earth electrodes. The cable arm will be earthen through the cable glands. The entire applicable infrastructure i.e. signal junction or command center shall have adequate earthing. Further, earthing should be done as per Local state national standard in relevance with IS standard.

Equipment which is supplied with voltages of 100 volt or more shall be provided with grounding terminals insulated from their frames. Control centre equipment shall be equipped with a grounding terminal of earth resistance of 10 ohms or less. Field equipment shall be equipped with a grounding terminal of earth resistance of 10 ohms or less.

Compensation for furnishing and installing grounding equipment shall be included in the prices of various bid items and no separate payment shall be made, therefore.

- a) Earthing should be done for the entire power system and provisioning should be there to earth UPS systems, Power distribution units, AC units, etc. so as to avoid a ground differential. The Employer shall provide the necessary space required to prepare the earthing pits.
- b) All metallic objects on the premises that are likely to be energized by electric currents should be effectively grounded.
- c) There should be enough space between data and power cabling and there should not be any cross wiring of the two, in order to avoid any interference, or corruption of data.
- d) The earth connections shall be properly made.
- e) A complete copper mesh earthing grid needs to be installed for the server farm area; every rack needs to be connected to this earthing grid. A separate earthing pit need to be in place for this copper mesh.
- f) Provide separate Earthing pits for Servers, & UPS as per the standards.
- g) The metallic housing of electronic equipment/junction box/panel shall be connected to the earthing system
- h) The active electronic parts of an electronic equipment system shall be connected to the earthing system

15 Protection against Lightning

The Contractor shall comply with lightning-protection and anti –interference measures for system structure, equipment type selection, equipment earthing, power, signal cables laying. The Contractor shall describe the planned lightning-protection and anti –interference measures based on national and International standards.

All outdoor equipment shall incorporate gap arresters or other suitable device approved by the Engineer to prevent lightning damages which may enter through input AC lines, communication cables, signal cables, detector feeder cables or other metallic elements exposed to the open air.

Compensation for furnishing and installing lightning protection equipment shall be included in the prices of various bid items and no separate payment shall be made, therefore.

Earthing of all equipment shall be made by using UL listed 3-meter copper bonded rod (minimum 250micron) with 17 mm dia, complying with NBC 2016, IS 3043 and IS/IEC

62305-1/2/3&4 standards. The resistance value shall be as low as possible in every case. Above ground metal piping in the process/valve area (subject to non-Cathodic protected) shall be Earthed.

From the viewpoint of lightning protection, a single integrated structure earth-termination system is preferable and is suitable for all purposes (i.e. lightning protection, power systems and telecommunication systems). The earthing system of a number of structures shall be interconnected so that a meshed earthing system is obtained. This will give low impedance between buildings and has significant lightning electromagnetic pulse (LEMP) protection advantages. Thus, different earthing systems like lightning protection earthing, electrical earthing, safety earthing, electronics earthing etc shall be interconnected.

Isolating spark gaps (ISG) shall be complying to IEC 62561-3, used at the places where direct interconnection is non-permissible to create equipotential bonding throughout the earthing system at the event of lightning with lightning impulse current (10/350 μ sec / Iimp) up to 100 kA and rated impulse sparkover voltage of ≤ 1.25 KV with IP 67 degree of protection.

1 Standards

All equipment for the project by the Contractor (included by the Contractor in the proposal) supplies shall be new and subject to the Factory Acceptance test to the satisfaction of the Engineer. Unless other standards are specifically required to be complied with herein or in the Contract, all materials and components used under the Contract and all design calculations and tests shall be performed in accordance with Indian standards.

In the absence of such standards in India, relevant clauses of international standards including but not limited to the International Electrotechnical Commission (IEC), Institute of Electrical and Electronics Engineers (IEEE), International Organization for Standardization (ISO), International Telecommunication Union Telecommunication Standardization Sector (ITU-T) shall be applied.

In the absence of such standards in India and the international standards mentioned above, industry standards generally accepted and approved in one of the major industrialized countries such as Great Britain, Japan, U.S.A, and Germany shall be applied.

Whenever in this Document reference is made to the Japanese Industrial Standards (JIS), British Standards (BS), American Association of State Highway Transportation Officials (AASHTO) standards, American Society for Testing and Materials (ASTM) standards, and American National Standards Institute (ANSI) standards, and the like, it shall be understood that equivalent internationally acknowledged standards will be accepted.

If Contractor offers materials, equipment, design calculations, or tests which conform to the standards other than those specified standards, full details of the differences between the proposed standard and the specified standards shall be submitted when required by the Engineer.

List of applicable standards for reference purpose is given in the table below

Standard	Description
ISO 10711:2012	Defines protocols and message sets between traffic detectors and traffic signal controllers. It is applicable to the various types of traffic detector technologies currently in use for real-time traffic signal controls.
	It defines message sets that contain data collection and control protocol for three different types of detectors of traffic signal control systems:
	<ul style="list-style-type: none">• Detectors that deal with occupancy information.
	<ul style="list-style-type: none">• Detectors that deal with image information; and
	<ul style="list-style-type: none">• Detectors that deal with vehicle identification.
	ISO 10711:2012 is limited to parameter generation to be used for traffic signal controls and for the interface between traffic signal controllers and detectors.

ISO 14813-5:2010	Requirements for the description and documentation of the architecture of Intelligent Transport Systems (ITS) in standards dealing with ITS. It also gives the definitions of terms to be used when documenting or referencing aspects of architecture description in those standards
ISO 14813-6:2009	<p>Provides a formal means to enact the ISO/TC 204 decision by resolution to use Abstract Syntax Notation One (ASN.1) for data definitions within ITS International Standards. This provides a common message form to enable interoperability and reuse. It provides consistency of use so that where other aspects of ASN.1 (defined within ISO/IEC 8824 and ISO/IEC 8825), such as transfer rules, are selected to be used, they are used in a common and consistent way in order to maximize interoperability and reuse.</p> <p>ISO 14813-6:2009 also provides a means where particular ITS sector requirements, or existent International Standards, that require particular message forms and procedures that are expressed in other notations (EDIFACT, XML, etc.), may be referenced and reused by other ITS applications. Thus, it presents an unambiguous system for identifying all the different data types and describing them in ITS International Standards in a common way.</p>
	The Data Registry described herein supports, and is designed to include, data concepts using alternative International, Regional or National System Architecture methodologies or techniques. A common Data Registry will ease migration and interoperability between such approaches.
ISO 14819-Part 1 to 6:2003-2008	Specifies the coding protocol for Radio Data System – Traffic Message Channel (RDS-TMC) – RDS-TMC using the ALERT-C protocol that is designed to provide mostly event-orientated road driver information messages.
ISO 14825:2011	<p>Specifies the conceptual and logical data model and physical encoding formats for geographic databases for Intelligent Transport Systems (ITS) applications and services. It includes a specification of potential contents of such databases (data dictionaries for Features, Attributes and Relationships), a specification of how these contents shall be represented, and of how relevant information about the database itself can be specified (metadata).</p> <p>The focus of ISO 14825:2011 is on ITS applications and services and it emphasises road and road-related information. ITS applications and services, however, also require information in addition to road and road related information. Typical ITS applications and services targeted by ISO 14825:2011 are in-vehicle or portable navigation systems, traffic management centres, or services linked with road management systems, including the public transport systems.</p>
ISO 14827-1:2005	<p>Defines the format that should be used to document those end-application messages that are to be exchanged between/among central systems. The format is protocol-independent to the extent practical. For example, this one format can be used to define data exchanges that may apply to DATEX-ASN, Common Object Request Broker Architecture (CORBA), or other Application Protocols.</p> <p>In general, each system can be viewed as consisting of the following interfaces:</p> <ul style="list-style-type: none"> • Application Interface • Operator Interface • Communication Interface • Database Interface

	Allows different systems to exchange relevant data. The relevant data will be contained in end-application messages. Each end-application message will be formally defined as either a “subscription” or a “publication”, according to the format as specified in ISO 14827-1:2005. DATEX-ASN defines how these end-application messages are packaged to form a complete data packet and also defines the rules and procedures for exchanging these data packets. Systems using DATEX-ASN are free to implement additional end-application functionalities according to the user requirements.
ISO 15628:2007	Road transport and traffic telematics, Dedicated Short Range Communication (DSRC) application layer Specifies the application layer core which provides communication tools for applications based on DSRC. These tools consist of kernels that can be used by application processes via service primitives. The application processes, including application data and application- specific functions, are outside the scope of ISO 15628:2007.
ISO 15662:2006	Provides information as a checklist to consider handling messages that are defined by the application working groups of ISO/TC204, installing systems and selecting suitable wide area communication systems for providing ITS application services.
ISO 15784-1 to 3:2008	Provides principles and documentation rules of application profiles used for exchange data and messages between a traffic management centre and roadside modules used for traffic management.
	The application profiles it specifies are used to exchange data and messages between a traffic management centre and roadside modules for traffic management and between roadside modules used for traffic management.
ISO 17267:2009	Specifies an Application Programming Interface (API) for navigation systems. It specifies the data that may be retrieved from the map database and defines the interface for access. This International Standard specifies a set of function calls. It also specifies the design of the API and gives examples of its intended use. Furthermore, it gives the criteria to determine whether a data access library is in accordance with this International Standard. ISO 17267:2009 is applicable to the following functional categories of navigation applications:
	<ul style="list-style-type: none"> • Positioning;
	<ul style="list-style-type: none"> • Route planning;
	<ul style="list-style-type: none"> • Route guidance;
	<ul style="list-style-type: none"> • Map display;
	<ul style="list-style-type: none"> • Address location;
	<ul style="list-style-type: none"> • Services and Point of Interest (POI) information access.
ISO 17572, Parts 1 to 3:2008	Specifies Location Referencing Methods (LRM) that describes locations in the context of geographic databases and will be used to locate transport related phenomena in an encoder system as well as in the decoder side. It defines what is meant by such objects, and describes the reference in detail, including whether components of the reference are mandatory or optional, and their characteristics. It specifies two different LRMs:
	<ul style="list-style-type: none"> • Pre-coded location references (pre-coded profile);
	<ul style="list-style-type: none"> • Dynamic location references (dynamic profile).
	It does not define details of the Location Referencing System (LRS), i.e. how the LRMs are to be implemented in software, hardware, or processes.
	ISO 17572-1:2008 specifies the following general LRM related sections:
	<ul style="list-style-type: none"> • Requirements to a Location Referencing Method;
	<ul style="list-style-type: none"> • Conceptual Data Model for Location Referencing Methods;
	<ul style="list-style-type: none"> • Inventory of Location Referencing Methods;

	<ul style="list-style-type: none"> • Examples of Conceptual Data Model Use;
	<ul style="list-style-type: none"> • description of selected UML Elements;
	<ul style="list-style-type: none"> • Comparison of Definitions with ISO/TC211
	<ul style="list-style-type: none"> • Introduction to the TPEG Physical Format.
ISO 22837:2009 (Probe Data)	Relates to vehicle probe data for wide area communications. It specifies the following.
	Reference architecture for probe vehicle systems and probe data, which provides a general structure for probe vehicle systems within which a wide range of actual probe vehicle systems can be built whose physical characteristics may differ (e.g., in their choice of communications medium). The reference architecture is used to: <ul style="list-style-type: none"> • clarify the major building blocks and logical interconnections of probe vehicle systems for which this standard will be used; • categorize probe data in accordance with the information model described below.
	Basic data framework for probe data elements and probe data, which defines probe data elements and probe messages, and specifically provides:
	Rules for mapping information models (as defined in ISO 14817) of probe data to probe data elements/messages. The information models show the logical structure of entities and concepts involved in probe data;
	<ul style="list-style-type: none"> • The required characteristics of probe data elements and probe data messages;
	<ul style="list-style-type: none"> • The notation for probe data elements/messages (in XML);
	<ul style="list-style-type: none"> • Rules for using core data elements and basic data elements (see below), and extensions of data elements in each application domain.
	<ul style="list-style-type: none"> • Core data element definitions, which are basic descriptive elements, intended to appear in every probe message, i.e. the location and the time at which the probe data was sensed.
	<ul style="list-style-type: none"> • Initial set of probe data elements, which are commonly used in typical probe data, enabled application domains, such as traffic, weather, and safety.
	Example probe messages, which define how probe data elements are combined to convey information to probe processing centres.
ISO 22951:2009	Relates to systems that use priority signal control functions to help emergency vehicles operate. This type of system is composed of a traffic management centre, in-vehicle units, roadside communication units, and roadside units. Public transport vehicles such as buses are also targeted to receive priority signal control service.
	The scope of standardisation includes message sets and data dictionary related to the communications as follows:
	<ul style="list-style-type: none"> • Between a roadside communication unit and each in-vehicle unit, • Between a roadside communication unit and other roadside units, • Between in-vehicle units and roadside units.
	ISO 22951:2009 concerns only information related to priority signal control and does not deal with information provision such as that of the situations at scenes. Since it is necessary to handle public transport vehicles in accordance with the conditions of individual cities and regions, the section in the messages and the data dictionary that are concerned with priority signal control for the vehicles are treated as an option. Furthermore, the standardisation does not depend on the type of communication medium used.

ISO 24097-1:2009	Establishes a Service-Oriented Architecture (SOA) for the realisation of interoperable ITS Web Services (WS). Web service behaviour is described at the metadata level (i.e. a higher level of abstraction) to enable auto generation of both a “Service requestor” programme, as well as a “Service provider” programme.
ISO 24099:2011	Defines the data structures and protocol(s) used in intelligent transport system (ITS) applications for the delivery and update of map-related data from Service Centre (SC) to users [(In-vehicle Systems (IVS))].
	The map centre specified in ISO 24099:2011 represents the supplier of map data and the Service Centre provides data and services to user devices.
	The term protocol as used in ISO 24099:2011 is a temporal sequence of map-related data interactions between system components that implement map-related data delivery and update. The delivery and update of map related data rely on existing communication technology.
ISO 24100:2010	States the basic rules to be observed by service providers who handle personal data in probe vehicle information services. This International Standard is aimed at protecting the personal data as well as the intrinsic rights and interests of probedata senders, i.e., owners and drivers of vehicles fitted with in-vehicle probe systems.
ISO 24531:2013	Assists ITS standards developers and users of ITS standards who wish to use XML, by providing a consistent definition of the rules and rule references for the use of XML within ITS. ISO 24531:2013 defines consistent rules and rule references to provide a framework to be used when implementing XML-based applications in ITS, and particularly in specifying XML in ITS standards, ITS data registries and ITS data dictionaries. ISO 24531:2013 also provides guidance and examples in respect of the use of XML in ITS, and the elaboration of XML within the ASN.1 data definition required by ISO 14813-6 and ISO 14817.
ISO 24978:2009	Provides a standardised set of protocols, parameters, and a method of management of an updateable “Data Registry” to provide application layers for “ITS Safety messages” using any available wireless media.
ISO TR 24532:2006	Clarifies the purpose of CORBA and its role in ITS. It provides some broad guidance on usage and prepares the way for further ISO deliverables on the use of CORBA in ITS.
ISO TR 25100:2012	Provides guidance on the harmonisation of data concepts that are being managed by data registry and data dictionaries such as those described in ISO 14817:2002.
	ISO TR 25100:2012 describes processes for harmonisation of such data concepts to arrive at preferred definitions for use in formal standards, specifications, technical reports and information models. It is based on consideration of a harmonisation process used by international groups involved in the ITS sector and in the wider sector of transport and logistics information and control systems.
ISO TS 18234-1 to 12:2006 to 2013	Provides set of TPEG applications and specifications. It allows the indexing of new applications as they are added to the TPEG applications family, by defining their Application Identification (AID).
ISO/TR 13184-1:2013	Specifies guidance information protocol to provide real-time decision support system to drivers or pedestrians using personal ITS stations:
	<ul style="list-style-type: none"> Reference architecture for real-time decision support systems This reference architecture provides a general structure for real-time decision support systems and the method of message exchange between the personal ITS station and the roadside ITS station. This reference architecture is used to build the interconnections between personal ITS stations and roadside ITS stations.

	<ul style="list-style-type: none"> Design method of application protocols for light-weighted devices. This Method is a flexible application protocol for safety warning and parking guidance services. Unlike many other application protocols in the ITS and Telematics domains, this protocol makes the client part independent of use cases for supporting light-weighted devices. Use cases at the road and parking bays for warning and parking guide ISO/TR 13184-1:2013 describes the use cases applicable to the communication services between personal ITS stations and roadside ITS stations for the purposes of providing safety warning and parking guidance.
ISO/TR 13185-1:2012	Specifies the communications architecture and generic protocol to provide and maintain ITS services to travellers (including drivers, passengers and pedestrians), using nomadic and portable devices.
ISO/TR 17452: 2007	Gives guidelines for using the Unified Modelling Language (UML) for defining and documenting interfaces between intelligent transport systems (ITS) and Transport Information and Control Systems (TICS). It presents these guidelines in the context of a case study for the creation of an ITS/TICS data dictionary and submissions to the ITS/TICS data registry.
ISO/TR 21707: 2008	<p>Specifies a set of standard terminology for defining the quality of data being exchanged between data suppliers and data consumers in the ITS domain. This applies to Traffic and Travel Information Services and Traffic Management and Control Systems; specifically, where open interfaces exist between systems. It may of course be applicable for other types of interfaces, including internal interfaces, but this Technical Report is aimed solely at open interfaces between systems.</p> <p>ISO/TR 21707:2008 identifies a set of parameters or meta-data such as accuracy, precision and timeliness etc. which can give a measure of the quality of the data exchanged and the overall service on an interface. Data quality is applicable to interfaces between any data supplier and data consumer but is vitally important on open interfaces. It includes the quality of the service as a whole or any component part of the service that a supplying or publishing system can provide. For instance, this may give a measure of the availability and reliability of the data service in terms of uptime against downtime and the responsiveness of the service or it may give a measure of the precision and accuracy of individual attributes in the published data.</p> <p>ISO/TR 21707:2008 is suitable for application to all open ITS interfaces in the Traffic and Travel Information Services domain and the Traffic Management and Control Systems domain.</p>
ISO/TR 24529:2008	<p>Deals with the use of UML within International Standards, Technical Specifications and Technical Reports and related documents.</p> <p>It discusses the application of the Unified Modelling Language (UML) to the development of standards within the context of ITS.</p>
ISO/TS 14823:2008	Presents a system of standardised codes for existing signs and pictograms used to deliver Traffic and Traveller Information (TTI). The coding system can be used to form messages to be handled by respective media systems, graphic messages on on-board units, and media system information on TTI dissemination systems [Variable Message Signs (VMS), Personal Computers (PC), Public Access Terminals (PAT), etc.] (Including graphic data).
ISO/TS 15624:2001	Transport information and control systems – Traffic Impediment Warning Systems (TIWS) System requirements
ISO/TS 20452:2007	Describes the functional requirements and Logical Data Model for PSF and API and the Logical Data Organisation for PSF that were completed under ISO/NP 14826. It does not specify a Physical Data Organisation.

ISO/TS 24530-1 to 4:2006	Establishes the top-level “containers” for TPEG messages in XML and the common data types that are used by tpegML applications (e.g. tpeg-ptiML). Inherently, tpegML is designed to “map” the TPEG binary (ISO/TS 18234 series), however, additional tags are provided to create a message and message set structure to facilitate internet file delivery.
ISO/TS 25114:2010	Provides a common framework for defining Probe Data Reporting Management (PDRM) messages to facilitate the specification and design of probe vehicle systems and gives concrete definitions of PDRM messages. ISO/TS 25114:2010 also specifies reference architecture for probe vehicle systems and probe data which incorporates PDRM, based on the reference architecture for ISO 22837, and basic data framework for PDRM instructions, which defines specifically necessary conditions for PDRM instructions, and notations of these instructions (in XML).
ISO/IEC 7498-1:1994	Information technology — Open Systems Interconnection — Basic Reference Model: The Basic Model
ISO 14812	Intelligent transport systems — Vocabulary
ISO 14813-1:2015	Intelligent transport systems — Reference model architecture(s) for the ITS sector — Part 1: ITS service domains service groups and services
ISO 14816:2005	Road transport and traffic telematics — Automatic vehicle and equipment identification — Numbering and data structure
ISO 14823:2017	Intelligent transport systems — Graphic data dictionary
ISO 14906:2018 with FD Amd 1	Electronic fee collection — Application interface definition for dedicated short-range communication
ISO 15628:2013	Road transport and traffic telematics — Dedicated short range communication (DSRC) — DSRC application layer Note to entry: A technically equivalent standard exists from CEN: EN 12834
ISO/TS 16460:2016	Intelligent transport systems — Communications access for land mobiles (CALM) — Communication protocol messages for global usage Note 1 to entry: Specifies messages harmonized with IEEE 1609.3. Note 2 to entry: Under systematic review.
ISO 16461:2018	Criteria for privacy and integrity protection in probe vehicle information systems
ISO 17419:2018	Intelligent Transport Systems — Cooperative Systems — Globally unique identification Note to entry: Under Vienna Agreement: EN 17419:2018
ISO 17423:2018	Intelligent Transport Systems — Cooperative Systems — Application requirements and objectives Note to entry: Under Vienna Agreement: EN 17423:2018
ISO/TS 17425:2016	Intelligent transport systems — Co-operative systems — Data exchange specification for in-vehicle presentation of external road and traffic related data Note to entry: Under Vienna Agreement: CEN TS 17425:2016
ISO/TS 17426:2016	Intelligent Transport Systems — Cooperative Systems — Contextual speeds Note to entry: Under Vienna Agreement: CEN TS 17426

ISO 17427-1:2018	Intelligent Transport Systems — Cooperative Systems — Roles and responsibilities in the context of co-operative ITS based-on architecture(s) for cooperative systems Note to entry: Under Vienna Agreement: EN 17427-1
ISO/TS 17429:2017	Intelligent transport systems — Cooperative ITS — ITS station facilities for the transfer of information between ITS stations Note 1 to entry: Under Vienna Agreement: CEN TS 17429 Note 2 to entry: Under revision with split into a multi-part document Cooperative intelligent transport systems (C-ITS) — ITS station facility services Part 1: Communication profile handler Part 2: Facility services handler Part 3: Content subscription handler
ISO 17465-3:2015	Intelligent transport systems — Cooperative ITS — Part 3: Release procedures for standards documents
ISO 17515-1:2015	Intelligent transport systems — Evolved-universal terrestrial radio access network — Part 1: General usage
ISO 17515-3:2019	Intelligent transport systems — Evolved-universal terrestrial radio access network — Part 3: LTE-V2X
ISO 18750:2018	Intelligent transport systems — Cooperative ITS — Local dynamic map Note 1 to entry: Under Vienna Agreement: EN 18750 Note 2 to entry: Includes EN 302 895 and additionally provides PICS for conformance testing
ISO 19414:2019	Intelligent transport systems — Service architecture of probe vehicle systems
ISO/TS 19091:2017	Intelligent transport systems — Cooperative ITS — Using V2I and I2V communications for applications related to signalized intersections Note to entry: Under Vienna Agreement: CEN/TS 19091
ISO 19079:2016	Intelligent transport systems — Communications access for land mobiles (CALM) — 6LoWPAN networking
ISO 19080:2016	Intelligent transport systems — Communications access for land mobiles (CALM) — CoAP facility
ISO/TS 19321:2020	Intelligent transport systems — Cooperative ITS — Dictionary of in-vehicle information (IVI) data structures Note 1 to entry: Under Vienna Agreement: CEN TS 19321
ISO/TS 20026:2017	Intelligent transport systems — Cooperative ITS — Test architecture
ISO 20922:2016	Information technology — Message Queuing Telemetry Transport (MQTT)
CEN/TS 21176	Cooperative intelligent transport systems (C-ITS) — Position velocity and time functionality in the ITS station Note to entry: Under Vienna Agreement: ISO/TS 21176
TS 21177:2019	Intelligent transport systems — ITS-station security services for secure session establishment and authentication between trusted devices Note to entry: Under Vienna Agreement: CEN/TS 21177

CEN/TS 21184:2020	Cooperative intelligent transport systems (C-ITS) — Global transport data management (GTDM) framework Note to entry: Under Vienna Agreement: ISO/TS 21184
ISO/TS 21185:2019	Intelligent transport systems — Communication profiles for secure connections between trusted devices Note to entry: Almost identical TS at CEN published with slightly different title: CEN/TS 17496 Cooperative intelligent transport systems (C-ITS) — Communication profiles
ISO 21186-1	Cooperative intelligent transport systems — Guidelines on the usage of standards — Part 2: Standardization landscape and releases
ISO 21186-2	Cooperative intelligent transport systems — Guidelines on the usage of standards — Part 2: Hybrid communications
ISO 21186-3	Cooperative intelligent transport systems — Guidelines on the usage of standards — Part 3: Security
ISO 21210:2012 with Amd 1:2017	Intelligent transport systems — Communications access for land mobiles (CALM) — Ipv6 Networking Note to entry: International Standard under revision with split into a multi-part document: Intelligent transport systems – IPv6 networking - Part 1: Common terms definitions and requirements Part 2: Addressing and forwarding Part 3: Mobility management Part 4: ITS station management adaptation entity
ISO 21212:2008	Intelligent transport systems — Communications access for land mobiles (CALM) — 2G Cellular systems
ISO 21213:2008	Intelligent transport systems — Communications access for land mobiles (CALM) — 3G Cellular systems
ISO 21214:2015	Intelligent transport systems — Communications access for land mobiles (CALM) — Infra-red systems
ISO 21215:2018	Intelligent transport systems — Localized communications — ITS-M5 Note to entry: Edition 2 (2018) includes EN 302 663 V1.2.1
ISO 21217:2014	Intelligent transport systems — Communications access for land mobiles (CALM) — Architecture Note 1 to entry: Edition 2 (2014) includes EN 302 665 Note 2 to entry: Under revision with new title: Intelligent transport systems — Station and communication architecture. Publication expected in 2020.
ISO 21218:2018	Intelligent transport systems — Hybrid communications — Access technology support
ISO 22418:2020	Intelligent transport systems — Fast service advertisement protocol (FSAP) for general purposes in ITS Note to entry: Under Vienna Agreement: EN / ISO 22418:2020.
ISO 24100:2010	Intelligent transport systems — Basic Principles for Personal Data Protection in Probe Vehicle Information Services
ISO 24102-1:2018	Intelligent transport systems — ITS station management — Part 1: Local management
ISO 24102-2:2018	Intelligent transport systems — ITS station management — Part 2: Remote management of ITS-SCUs

ISO 24102-3:2018	Intelligent transport systems — ITS station management — Part 3: Service access points
ISO 24102-4:2018	Intelligent transport systems — ITS station management — Part 4: Station-internal management communications
ISO 24102-6:2018	Intelligent Transport Systems — ITS station management — Part 6: Path and flow management
ISO 24102-7	Intelligent transport systems — ITS station management — Part 7: ITS-S capabilities Note to entry: Under development
ISO 24102-8	Intelligent transport systems — ITS station management — Part 8: ITS-S application processes Note to entry: Under development
ISO 24102-9	Intelligent transport systems — ITS station management — Part 9: ITS-S managed entities Note to entry: Under development
ISO 24103:2009	Intelligent transport systems — Communications access for land mobiles (CALM) — Media adapted interface layer (MAIL)
ISO 24978:2009	Intelligent transport systems — ITS Safety and emergency messages using any available wireless media — Data registry procedures
ISO 25111:2009	Intelligent transport systems — Communications access for land mobiles (CALM) — General requirements for using public networks
ISO 29281-1:2018	Intelligent transport systems — Localized communications — Part 1: Fast networking & transport layer protocol (FNTP)
ISO 29281-2:2019	Intelligent transport systems — Localized communications — Part 2: Legacy system support
ISO 29282:2011	Intelligent transport systems — Communications access for land mobiles (CALM) — Satellite networks
ISO 29284:2012	Intelligent transport systems — Event based Probe Vehicle Data
ISO 14817:2002	Specifies the framework, formats, and procedures used to define information exchanges within the Intelligent Transport System/Transport Information and Control Systems (ITS/TICS) sector. It defines the content of the ITS/TICS central Data Registry and Data Dictionaries, the registration process to enter data concepts into the Data Registry. Throughout the text, the Data Registry should be taken to mean the ITS/TICS central Data Registry.
	Specifically, ISO 14817:2002 specifies:
	<ul style="list-style-type: none"> • Framework used to identify and define all information exchanges; • Framework used to extend standardised information exchanges to support local customisations and combinations; • Information modelling method for defining ITS/TICS data concepts, when used; • Meta attributes used to describe, standardize and manage each of the data concepts defined within this framework; • Requirements used to record these definitions; and • Formal procedures used to register these definitions within the Data Registry.

Table 3-1: List of Applicable Standards

16 Cabinet/Junction Box

- a) All equipment cabinets for outdoor uses shall be of rainproof and rustproof construction with smooth exterior and adequate protection against moisture condensation and shall be made of high-quality steel or stainless-steel plates of adequate thickness. Steel plate cabinets shall be treated with sand blast before painting or equivalent rustproof measures.
- b) The Contractor shall provide the Cabinet/Junction Boxes, posts and cantilever to mount the field sensors like the cameras, traffic sensors, traffic light aspects, ATCC active network components, controller and power backup (UPS/Alternate energy sources) at all field locations, as per the specifications given in the RFP.
- c) Cabinet/Junction Box needs to be appropriately sized in-order to accommodate the systems envisaged at the Junctions, and the Contractor should design the Junction box for 1.5 times the actual size the Contractor requires for utilization under the ITS project.
- d) The Cabinet/Junction Box should be designed in a way that, separate compartment will be available for separate system (i.e., Controller, Mini server, Active component, etc.). Each compartment shall have lock & key facility. There should be provision made to integrate the systems if required.
- e) The cabinet/Junction Box shall be made of hot-rolled mild steel plate complying with ISO 3573 or equivalent having thickness of 2.3 mm or stainless-steel plates of adequate thickness. Steel plate cabinets shall be treated with abrasive blasting before zinc thermal painting complying with ISO 2063 or equivalent. Then two coating of polyurethane resin enamels and varnishes shall be applied before the cabinet is painted in final color.
- f) Cabinet/Junction Box doors shall permit complete access to the interior of the cabinet and shall encompass essentially the whole area of the front surface of the cabinet. All door hinge pins shall be of stainless-steel construction.

17 Support Structure

The structural steel should be complied with IS 2062. The structure to support the equipment including the message board for VMS, the signal aspect for ATCS and cameras for TIDS, Camera for RLVD and Radar for SLVD, ANPR Cameras etc., shall be sturdy and aesthetically designed and capable of bearing wind loads up to 200 km/h.

Hot dip galvanization with thickness of 80-100µm average in accordance with American standard ASTM A123. An anti-corrosive paint which shall be effective over the temperature range minus 25 degC to 70 deg C shall be applied. Any signs of rust or corrosion occurring within the guarantee period shall be deemed a defect and the Contractor shall be responsible for correcting, at his own expense, the defect to the satisfaction of the Employer.

The Type and number of Support Structures given in this RFP for each equipment may vary during implementation, however during the detail design the Contractor required to provide all the necessary Support Structure's based on the detailed design and actual site condition and approved by the Engineer.

The type and the number of the road signs proposed by the Bidder as per the design shall be mentioned by the Bidder in the detailed BOQ in the detail design period. The cost of the Road Signs and materials that is not explicitly listed in the BOQ of the Bid submitted by the Bidder or supplied by the Bidder during the installation works but deemed necessary for the system during any stage of this Contract shall be included in the cost of appropriate items and the Contract Price, and no separate payment shall be made.

18 Radio Interference

All data processing and transmission equipment shall be designed to prevent radio interference with the satisfactory operation of other equipment regardless of whether the interference be due to radiation, induction or conduction.

19 Road Signs

Necessary Road signs including Direction, Location Name, safety etc to be provided as following by the Contractor as per requirement of the site according to IRC 67.

Table 19-1: Necessary Road Signs

Sl.No.	Signages	Qty/ Unit	Nos
1	Signages at ATCS Junction		
	• Mandatory/Regulatory circular sign boards (Size of 600mm dia)	Nos	84
	• Informatory -square sign boards (Size of 300mmx300mm)	Nos	42
	• Warning /Cautionary -triangular sign boards (Size of 600mm)	Nos	189
	• Reflective road studs (Size of 50mmx100mmx102mm)	Nos	80,000
2	Signages at RLVD locations		
	• Cautionary Square Sign boards (Size of 300mmx300mm)	Nos	177
	• Informatory Sign on Gantry Boards (Size of 9600mmx2600mm)	Nos	135
3	Signages at SLVD locations		
	• Speed warning Square sign board (Size of 300mmX300mm)	Nos	11
4	Signages at TIDS locations		
	• Cautionary -Square Sign board (Size of 300mmx300mm)	Nos	58
5	Signages at ATCC locations		
	• Cautionary -Square sign board (Size of 300mmx300mm)	Nos	230

The type and number of Road Signs given above are indicative and minimum in number, however during the detail design the Contractor is required to submit detailed design and detailed BOQ to Engineer for approval. The cost of the Road Signs and materials that is not explicitly listed in the BOQ of the Bid submitted by the Bidder or supplied by the Bidder during the installation works but deemed necessary for the system during any stage of this Contract shall be included in the cost of appropriate items and the Contract Price, and no separate payment shall be made.

20 Civil Works

20.1 General

-
- (a) The construction and/or installation of the civil works shall be performed in accordance with the specifications stipulated hereinafter.
-

-
- (b) Other installation details not specified herein shall be governed by the Contractor's own specifications approved by the Engineer.
 - (c) The Contractor shall provide adequate safety guards and warning signs, such as indicating boards, lights, barricades and other proper warning signs as required during excavation, handhole construction, signal pole and foundation construction, roadside equipment pole and foundation, VMS gantry construction and foundation, Tunneling Mechanical Duct Boring such as horizontal directional drilling (HDD) or pipe jacking construction (PJC), laying of ducts, installation of riser pipe, intersection improvement repair works, installation of road marking and all other construction and/or installation activities. At a place of congested traffic or hazardous location, the Contractor shall consult with the local authorities concerned.
 - (d) The Engineer shall be able, at any time when deemed necessary during the construction period, to carry out inspections and/or tests on the facilities under construction and/or the portions of facilities completed by the Contractor. In case of any error in construction, faulty materials and/or other evidence of unsatisfactory construction and installations are discovered in the course of such inspection and/or tests, the Contractor shall immediately repair, replace and remedy such unsatisfactory items.
 - (e) The Contractor is responsible at his own expense to prove that the quality and quantity of the hidden portions comply with the Specifications. A photograph may be applicable as one of the measures.

20.2 Detailed Survey and Design

Before commencing the actual work, the Contractor shall carry out the detailed survey/ design of the civil facilities for the Project considering the standards stipulated in specifications. The detailed drawings including the calculation data based on the said survey/ design shall be prepared and shall be submitted to Engineer for approval.

The kind of construction drawings are as follows.

- (a) Shop drawings of Civil Works
- (b) Detailed drawing of handhole with calculation data
- (c) Detailed drawing of VMS gantry and foundation with calculation data
- (d) Detailed drawing of signal pole and roadside equipment pole and pre-cast pole foundation with calculation data
- (e) Horizontal directional drilling or pipe jacking detailed plan
- (f) Design of handhole and covers with calculation data
- (g) Special design drawings (If necessary)
- (h) Bill of Quantity (Handhole, PVC pipe, HDPE pipe, GI pipe, Riser pipe, Road marking work and etc.)

20.3 Handhole and Foundation

Requirements of handhole, signal pole foundation, roadside equipment pole foundation and gantry foundation are as follows:

(1) General

VMS gantry foundation and RLVD gantry foundation shall be constructed with a ready-mixed or site-mixed concrete. But Handhole, signal pole foundation and another roadside equipment pole foundation shall be basically pre-casted. But Contractor can propose any type of foundations if required for the site situation. Such foundation shall be designed by the Contractor and subject to the Engineer's approval.

(2) Type of Handhole

Standard type of the handhole shall be as follows:

- (a) Inner dimension: Length 1.0 (m) x Width 0.5(m) x Depth 0.8(m)
 - (b) Material of handhole cover: Iron
-

(3) Special Type of Handhole

Any special type of handhole other than the standard type shall be designed by the Contractor complying with the following requirements. The designed drawing and the strength calculation data shall be submitted to the Engineer for approval.

- (a) The handhole shall have the dimensions suitable for amount of cables to be put through it and shall have sufficient width to provide working clearance of 70 cm.
- (b) The handhole shall be so designed that cable placement does not restrict the future utilization of the chamber and the ducts.
- (c) The handhole on sidewalk shall have an iron cover and frame which are to satisfy the following grades specified in the Indian Standard (IS) 12592:2002.
 - LD (Light Duty)-2.5 for the iron cover and frame on the sidewalk
 - HD (Heavy Duty) -20 for the iron cover and frame on the carriageway

(4) Location of handhole

The handhole shall be constructed at locations specified in the duct system plan or construction drawings to be approved by the Engineer. And the handhole shall be watertight.

(5) Mixing, pouring, and curing of the concrete

The Contractor shall comply with the following specifications for mixing, pouring and curing of the concrete.

- (a) The concrete for handhole and foundation including precast products, when made with a normal Portland Cement, shall attain a minimum compressive strength of 2,100N/cm² (210kg/cm²) in 28 days (cylinder type), or when made with a high rapid strength Portland Cement, it shall acquire the same strength in 7 days (Test to be performed on cylindrical type concrete specimen of size 150mm x 300mm).
- (b) The slump range for the concrete used in the construction of handhole, gantry foundation, signal pole foundation and roadside equipment pole foundation shall be between 8 and 15cm and enough reinforcement shall be considered.
- (c) The Engineer may order three (3) test pieces (cylinder type) from any batch of the concrete to be taken and properly marked for the laboratory test required. The Contractor shall conduct the laboratory test of such test pieces in the presence of the Engineer.

(6) In the construction of foundation of the concrete

The concrete shall be slowly placed around the moulds or forms up to adequate level evenly and tamped into all parts of the moulds or forms by using vibrator until a densely solid mass without cavities is obtained.

(7) Requirement of the bottom of pit

The bottom of pit shall be tamped and carefully levelled and shall be covered with approximately 5 to 10 cm of lean concrete, excepted in case of handholes, gantry foundation, signal pole foundations and roadside equipment pole foundations.

(8) Cement mortar

Cement mortar shall consist of one (1) measure of Portland Cement and two (2) measures of M-sand. The materials shall be thoroughly mixed in a dry state on a non-absorbent base and then worked up with sufficient water to form a stiff paste. Mortar, once mixed, shall be promptly used. If not used within one hour, the mixture shall be condemned and shall not be used.

(9) Removal of inner and outer forms

Removal of inner and outer forms shall not be permitted within 5 days after placing of concrete.

(10) Treatment of surrounding area of gantry foundation

Upon the removal of outer forms, surrounding area of gantry foundation shall be immediately backfilled. All gantry foundation construction including concrete mixing and placing shall be done in the presence of or under the authority of the Engineer.

(11) Pre-cast Handhole, Signal pole foundation and Roadside equipment pole foundation

Visual inspection of the precast handhole and foundation shall be conducted in accordance the detailed drawings including the calculation data approved by the Engineer at a manufacture of them in attendance with Engineer. The inspection items shall be as follows:

- Apparent condition inspection (crack, break)
 - Numerical inspection
 - Dimension inspection
- Tolerance of dimension shall be within 2.0 cm.

20.4 Excavation for Civil Construction Site

Requirement of excavation for civil construction site (Handhole, Duct, Signal Pole Foundation, Roadside Equipment Pole Foundation, Gantry Foundation and Others) are as follows.

- (a) All excavation shall be done in a thorough and workmanlike manner in accordance with the detailed drawings and the Specifications.
- (b) The Contractor shall take all countermeasures necessary for safety of the public and for protecting and preserving any and all temporary or permanent utilities
- (c) The Contractor must carry out a test pit survey and confirm the underground facility before construction.
- (d) The Contractor shall obtain all pertinent records from the Electric, Water Supply, and Sewer Authority and other organizations for underground utilities in order to proceed his work and safeguard to other utilities.
- (e) The Contractor shall be directly responsible for all damages to existing utilities and shall restore these services immediately at his own expense.
- (f) During the execution of the work, if existing underground facilities are interrupted, or any part thereof is disturbed, The Contractor shall immediately notify the facts to the Engineer and the owner of the utility.
- (g) If the presence of underground facilities is suspected or when required by the Engineer and the Contractor shall at his own expense excavate test pits at the location in question.
- (h) If any obstructions that interfere with the excavation of the civil construction site (handhole, duct, signal pole foundation, roadside equipment pole foundation and gantry foundation) trench in conformity with the detailed drawings and these specifications are encountered, The Contractor shall consult the Engineer about alternate plans to be initiated.
- (i) The Contractor shall cart away all excavated materials except that to be used for backfilling.
- (j) Upon completion of the backfilling, all remaining soil shall be removed and the road surface, pavement and the area concerned shall be immediately cleaned.
- (k) The Contractor shall always adequately protect the sides of the excavation against cave-in.
- (l) The Contractor shall confer with the proper road administrative authority (GCC, HMPD, NHAI and any other authority) to ensure that the proposed depth of ducts conform to the final grades and levels of carriageways and sidewalks.
- (m) The Contractor shall excavate as far as possible to comply with the trench width requirement as detailed in the Construction Drawings and these specifications. Any excess in this width, unless specifically authorised by the Engineer, shall be at the Contractor's own expense. This includes the extra restoration expenses for pavements, and/or tiles.

20.5 Installation of Ducts

- (a) Installation of ducts shall be carried out in accordance with the specifications provided hereinafter.
 - (b) Other installation details not specified herein shall be in accordance with Contractor's own specifications subject to the Engineer's approval.
 - (c) HDPE pipe and PVC pipe bend pipe having 90-degree angle shall be used for the section between the handhole and riser pipe.
 - (d) The Employer and the Engineer may examine the quality of ducts and duct trench when required, before Contractor commences the duct placing work.
-

(e) The ducts shall be installed in a straight line, horizontally and vertically, wherever practicable.

- (f) Trenching, restoration shall be carried out in accordance with the approved detailed drawings and the Specifications.
- (g) The clearance between the ducts formation and trench wall shall be at least 5cm - wherever applicable.
- (h) Duct runs must be completed from the handhole without interruptions or breaks and must be installed with perfect alignment of the duct way.
- (i) The covering depth is given below in the table and any variation in that shall be approved by the Engineer and Employer wherever deemed necessary.
- (j) The covering depth from the top of the pipe to the surface of ground shall be as follows:

Table 20-1: Standard Depth

Location	Depth[m]
Sidewalk	0.60 or more
Carriage way	0.90 or more
Road crossing (Opened trenches)	1.20 or more
Road crossing (Tunneling by mechanical duct boring section)	1.50 or more

20.6 Removal of Existing Facilities and Restoration

20.6.1 Removal of Existing Facilities

The Contractor shall remove the existing facilities at installation location. The Contractor shall coordinate all necessary related stakeholders and prepare the safety measures for the work. The Contractor shall consult with the Employer about how to deal with the removed facilities and if necessary, move them to the Employer's warehouse.

20.6.2 Restoration

The Contractor shall carry out the backfilling work after removal of the existing signals at installation location. Before the work, all fallen objects shall be removed from the excavation. Upon completion of the work, all remaining soil shall be removed and the road surface, pavement and the area concerned shall be immediately cleaned.

The Contractor shall carry out the temporary restoration so that traffic shall not be interrupted until the permanent restoration is carried out. After the immediate temporary restoration, the Contractor shall ensure the permanent restoration of the road to its original conditions. To do so, he shall contact the relevant authorities and follow their requirement.

Chapter 2 Requirements of Traffic Information

& Management System Chapter 2-1

Requirements of Control Centre and

Datacenter for TIMS

1 General

Traffic Information & Management System Command Control Centre (TIMS-CCC) approximate size of 7500 Sq Ft. will be established in the Chennai Traffic Police building as an operation core to monitor, manage and control traffic and incidents in the Chennai Metropolitan Area.

The CITS Project is composed of many components systems. These systems are expected to perform their functions to achieve overall objective for the efficient, safe and smooth traffic in the City.

The Contractor shall provide and construct a central server system that manages various systems comprising the traffic surveillance, Enforcement, Signal Control, information dissemination and control system in an efficient manner, provides user-friendly human machine interface for the operator and records all events and incidents related to the CITS Project. System shall be expandable to account for increase in field installed devices.

All the supplied equipment shall operate on 230 V, 50 Hz single -phase power supply. Power for all the equipment will be conditioned using on-line UPS with minimum 3 or more hours of back up. If any equipment operates on any voltage other than the supply voltage and supply frequency, necessary conversion/correction device for supply shall be supplied along with the equipment.

All the control equipment e.g. file servers, database servers, video recording server, SAN/NAS/Raid backup device, decoders, networking equipment etc. shall be provided in standard Racks.

System shall have WAN connectivity for remote monitoring. Backup should be maintained to protect against storage failure. Contractor shall provide all technical details regarding data formats, communication protocols, packet formats, etc.

All the modules supplied (TIDS, Cameras, VMS, SLVD, RLVD, Roadside Communication etc.) shall deliver data and reports that are safety-centric (fatal collisions in a given stretch, violation of regulation etc.), enforcement-centric (number of tickets issued, comparison of violations on monthly basis etc.) as well as equipment-centric (failed packets, number of repairs carried out on field devices, down time on account of major faults etc.)

The system shall provide detailed reports related to the System Operations (including the actions of various stakeholders during Incident Management) and Maintenance. The format

for the same shall be finalized by the Contractor in consultation with Engineer. Maintenance reports, at the minimum, shall include the current operational status of each equipment, actual events of Down-times of each equipment, actual events of Mean time to Repair of each equipment and actual events of Meantime between failure of each equipment and the preventive & repair maintenance log.

The system shall also provide a method to log and report road incidents. Data used for logging and reporting shall be 'picked-up' automatically from the road-side and other sensors to the maximum extent possible.

Further the system shall provide a facility of generating user-formatted reports that can, for example, bring together the occurrence of incidents, enforcement, violations, values of various sensors and the operational status of various equipment on a common timeline / scale.

The main objectives of the TIMS-CCC are minimum listed below but not limited.

Traffic Information

Integrated and interoperable ITS platform to collect data for analysis of congestion, average speed, density, travel time estimation from various resources:

- (a) Probe data from CAD/AVL
- (b) Traffic information from ATCC
- (c) Incident information from TIDS
- (d) Violation information from SLVD and RLVD
- (e) Traffic information from external resources such as external agencies, systems and road users

Traffic Enforcement

Enforcement of various traffic violations.

- (a) On-road checks
- (b) Speed violations
- (c) Red light violations
- (d) Entry restriction violations
- (e) Data provision for violated vehicle (e-Challan System)

Monitoring and Management of Traffic

Management and Monitoring of traffic situation in the city.

- (a) Signal Timing and Operations
- (b) Road Network Surveillance
- (c) Active Traffic Management using:
 - ✓ Adaptive signal control (via ATCS)
 - ✓ Queue alerts (via VMS)
 - ✓ Dynamic rerouting (via VMS)
 - ✓ Dynamic & scalable data availability for external VMS
 - ✓ Monitoring traffic incidents and taking steps towards restoration of defective situation (via TIDS)

Interfacing with various agencies to integrate information impacting traffic flows

- (a) Transit agencies (MTC / CBS System etc.)
- (b) Construction/Maintenance agencies
- (c) Weather system
- (d) Incident/Events/Disaster management agencies
- (e) Support traffic management activities related to planned events in coordination and collaboration with other city agencies.
- (f) Sharing of traffic data and information with various agencies such as transit, road construction and maintenance, police etc. to help such agencies to monitor and control their respective operations more efficiently.

Dissemination of Traffic Information to Public

- (a) Dissemination of traffic information to public through variable message signs, website, mobile application, social media, SMS as required, WhatsApp message, Call center/Help Line etc.
- (b) Scalable incident/Traffic Information data availability to external agency according to define standard protocol

Data Repository and Analysis

- (a) Storage of traffic data and sharing the same with planning agencies in order to support transport planning measures in the city.
 - (b) Analysis of traffic related data to support infrastructure planning and design.
 - (c) Traffic flow analysis.
 - (d) Providing inputs to road agencies in junction planning and layout design.
 - (e) Support traffic and law enforcement measures through analysis of data from automated detection and recording of traffic violations such as speed limits, red light violation, stop-line violation, No helmet detection, Tripling riding and Blacklisted vehicle.
-

- (f) Support identification and analysis of black spots in case of accidents.

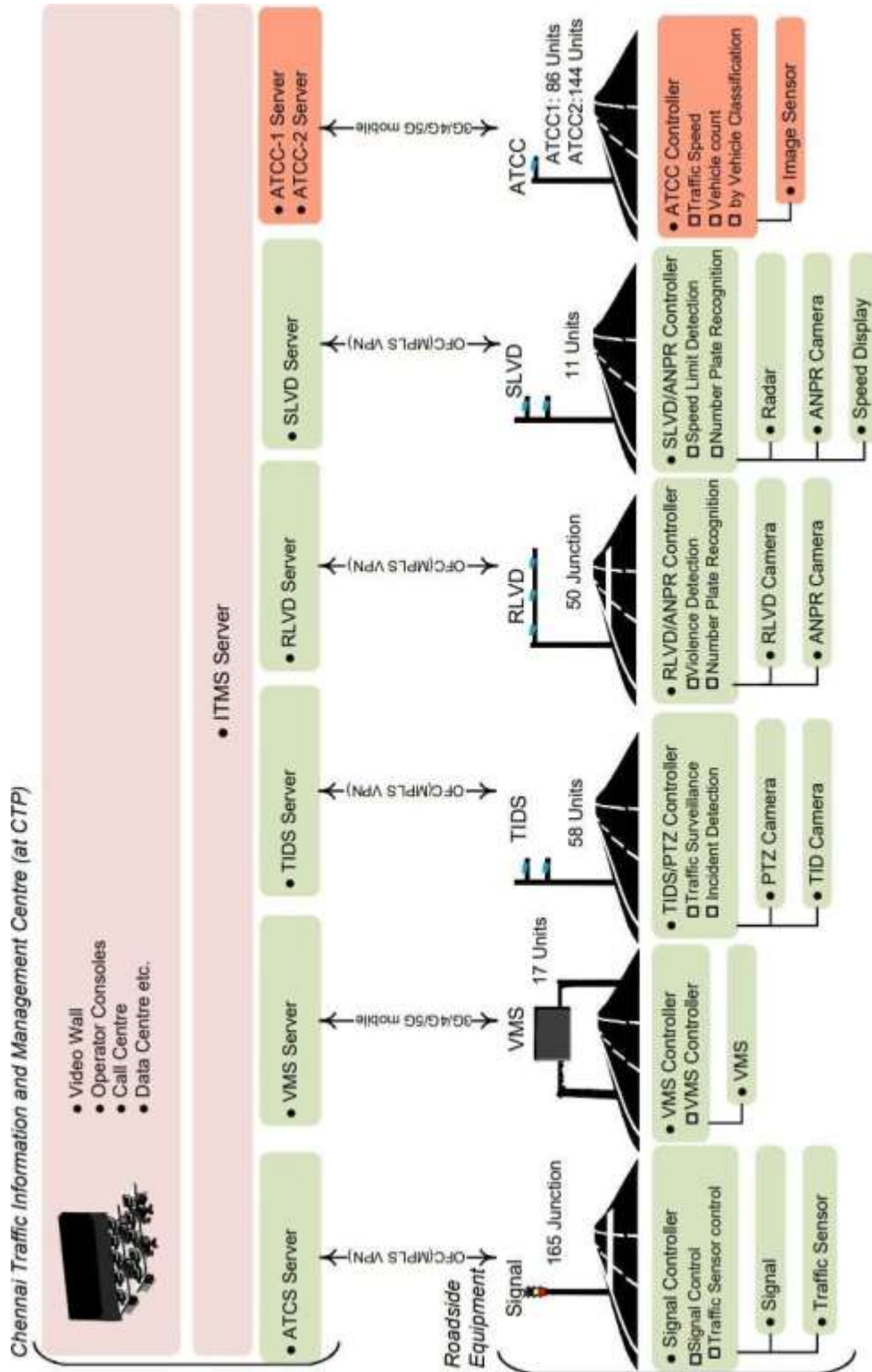


Figure 1-1: Concept of TIMS Functions

2 System Configuration

The system configuration of the Chennai TMS is shown in the figure below.

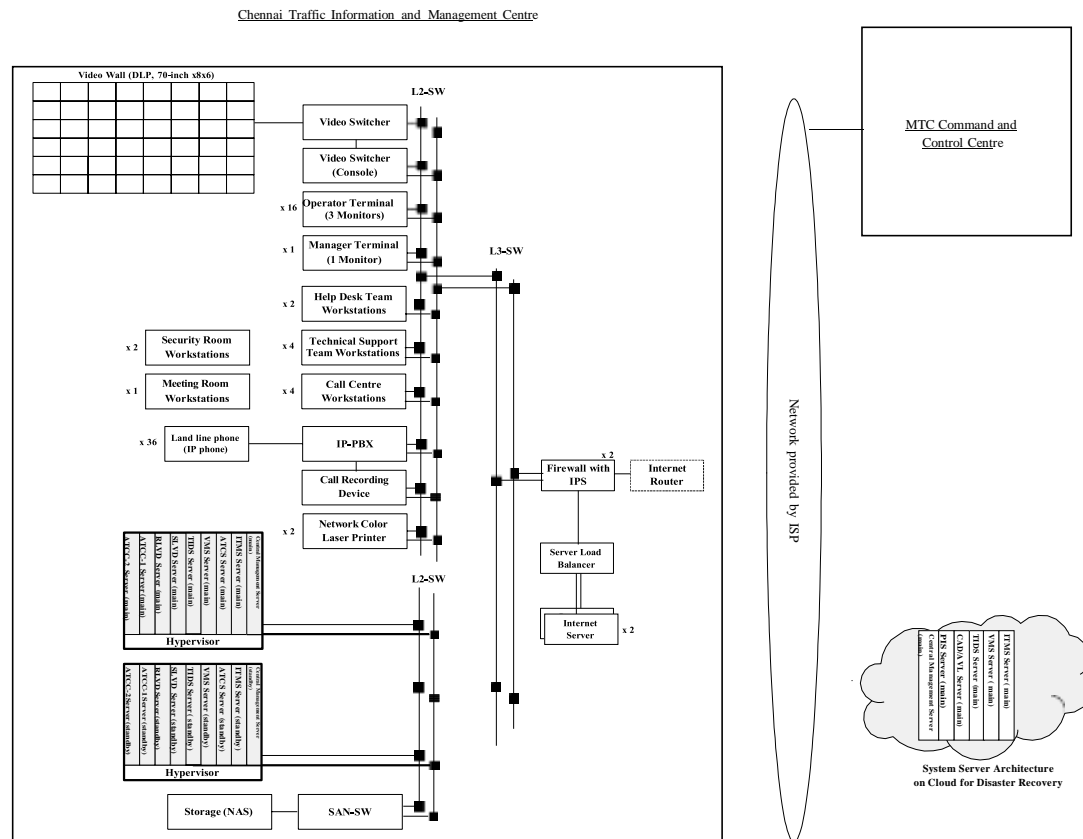


Figure 2- 1: System Configuration of TIMS Command Control Center

3 Equipment Location

TIMS CCC will be established in the Office of Commissioner of Police. CTP has initiated the process of construction of a new building in the premises of Office of Commissioner of Police – Vepery. One floor will be allotted for CCC. If there is a delay in construction, any other temporary space shall be arranged by CTP for establishing the CCC temporarily. If required, the shifting of the CCC from temporary location to permanent location shall be in the scope of the Contractor. The necessary interiors and arrangement for smooth operations shall be in the scope of the Contractor

The location of CCC building is shown in the table below

Table 3-1: Location of Chennai TIMS CCC

No.	Location Type	Location Name
1	TIMS Command Control Center	Office of Commissioner of Police, Vepery

4 Layout

The TIMS-CCC will be to monitor, manage and control city traffic movement as well as

incidents. The entire design proposal must be Flexible, Dynamic, Scalable, Expandable, and re-deployable to accommodate any technological changes / future needs which are not envisaged now. Hence 100% modular interior system (prefabricated and ready to install) solution is required. In a typical control room, the environment is defined by four major components viz: Ceiling, Flooring, Control Desks & Wall

panelling as 90% of the visible area is defined by these components. To achieve must needed quality interms of integrity, functionality, safety & ergonomics and to avoid interface related issues during and after execution. It is mandatory for the main bidder that the control room interior solution provider supplies all elements/components like ceiling, flooring, control desks, panelling, partitions & luminaires (to comply with ISO 11064) and completes the installation activities of the same.

Details of TIMS-CCC layout shall be as per the following table below.

Table 4-1: Details of TIMS-CCC Information

Details of TIMS-CCC Information			
A	Civil Work (False Floor, Ceiling, Ducting, Access Doors, Painting, Partitioning etc.)		
Code	Item Name	UOM	Quantity
A.1	TIMS Operation Room	Nos	1
A.2	Meeting/Situation Room	Nos	1
A.3	Call Center Room	Nos	1
A.4	Technical Support Room	Nos	1
A.5	Meeting Room separated with glass glazing	Nos	1
A.6	Electrical Room & Utility Room	Nos	1
A.7	Storeroom	Nos	1
A.8	Washrooms	Nos	1
A.9	Pantry	Nos	1
A.10	Entrance for Telecom Component (Fibre cabling etc.)	Nos	1
A.11	Conference Room	Nos	1
A.12	Reception Area	Nos	1
A.13	Data Centre	Nos	1
A.14	UPS Room	Nos	1
B	Additional Requirement		
B.1	Any other Item as necessary	Lot	1

i. TIMS Operation Room

TIMS-CCC will be primary workspace that service utilize by associates, Chennai Traffic Police and technocrats to monitor, manage and troubleshooting critical issues, incident, disaster round the clock proactive monitoring for traffic related to Chennai city, such as Traffic monitoring, Traffic routing information, violation and enforcement etc.

The operation area of TIMS-CCC will be used by Chennai Traffic Police, operation and maintenance staff for various services such as Probe Internet, ATCC, ATCS, VMS, TIDS, Enforcement System,

, GIS, Asset management and call center.

The Video Display Wall envisaged with 48 (70”) nos. of cubes placed adjacent to each other and each of the clusters with 8x6 LED Panels/ screens. The screens selected shall be full HD LED panels/screens, with associated video wall controller, display software with edge blending feature.

ii. **Meeting /Situation Room**

This area of TIMS-CCC consists of separate area covered with glass wall. In the event of any critical situation the technology decision makers and CTP authorities will meet here. This place will be equipped with Led screen, Table Mic, speaker, Projector, IP Phone.

iii. Call Center Room

The call center will log and track all the ticket, inquiry, information raised either by call, SMS, Email, Web Portal, Mobile APP and in-person. System will automatically track and maintain detail until unless ticket is not resolved.

The call center equipped with latest technology option and provide service in city wide user related information for traffic in guidance of CTP. The detail SOP will be defined and developed by the Contractor for approval by Engineer and Employer.

iv. Technical Support Room

Technical support room shall have a sitting arrangement of various technical staff who shall be responsible for providing technical assistance during operation stage of the project.

v. Meeting Room separated with glass glazing

This area of TIMS-CCC shall be for regular meetings & discussion held between TIMS team, CTP etc. Meeting room shall be separated with glass glazing and equipped with LED Screen, IP phone.

vi. Electrical Room & Utility Room

This area of CCC shall consist for electrical distribution for equipment of the control centre and any other related utility.

vii. Storeroom

This area of CCC shall be kept for maintaining the required spares for CCC. Required spare parts shall be used by the Contractor in order to keep up and running the operation as per defined SLA.

viii. Entrance for Telecom Component (Fibre cabling etc.)

The separate area to keep fibre from telecommunication (Service Provider).

ix. Conference Room

This area of CCC is for discussion and information exchange / meetings with external agency (Press, Media, Other government body). This area shall be separate from main area of CCC due to access of external personals

x. Services

For continuous and smooth operation of TIMS-CCC the required internet service, DTH services any other consumable and non-consumable item or service required will be in scope of the Contractor.

xi. Data Centre

The data centre shall be used to house all active equipment like all Application and Database Server with primary and redundant capability, Network Switch, IP communication equipment etc. in logical perspective, for ITMS application, ATCC, ATCS, VMS, TIDS, RLVD, SLVD, TIMS, Authentication etc.

Data center of TIMS-CCC shall be the heart and core of Chennai ITS Project to maintain important information and serving communication between field equipment and central system servers. All information held and processed by data center is subject to the risks of attack, error and natural disaster, and other vulnerabilities inherent to its use.

The up time of the CITS Project systems shall be high and shall maintain security up to high level for data, equipment etc. by the Contractor.

The grounding system for the data center shall not just for protection against lightning strike but also it shall be an active functioning system that provides protection for personnel and equipments. Proper grounding is essential for efficient system performance. Surges that are not properly dissipated by the grounding system introduce electrical noise on data cables.

The Contractor shall maintain following standards for Data Center

- TIA – 942: Telecommunications Infrastructure Standard for Data Centres - TIA – 942 defines practical methods to ensure electrical continuity throughout the rack materials and proper grounding of racks and rack – mounted equipment. This is the only specification that addresses problems specific to data centre infrastructure.
- ISO 27001 – ISMS: The Data centre should comply with ISO 27001 – ISMS guideline provided by International Organization for Standardization. This standard helps organizations keep information assets of the Data centre secure.
- Guideline of MUHA and relevant update time to time

xii. UPS Room

All the required UPS for TIMS-CCC shall be installed in this room to main origin of power to control center. This room shall be under surveillance and restricted area. All the entry & exit log shall be maintained using automatic system for audit.

5 Architectural Requirements

Table 5-1: Architectural requirement of Control Centre and Datacentre

No.	Requirement
False Ceiling & Metal Paneling	
1.	<ul style="list-style-type: none"> ■ Providing and fixing mineral fibre false ceiling tiles at all heights of size 595X595mm of approved texture, design and pattern. The tiles should have Humidity Resistance (RH) of 99%, Light Reflectance > 85%, Thermal Conductivity k = 0.052 - 0.057 w/m K, Fire Performance as per (BS 476 pt - 6 & 7) in true horizontal level suspended on interlocking T-Grid of hot dipped all round galvanized iron section of 0.33 mm thick (galvanized @ 120 gsm) The same shall be inclusive of cut outs for lighting, AC grills, Fire detectors, nozzles, etc. ■ Control Room wall panelling and ceiling must be 100% modular to accommodate future technological expansions/retrofitting without taking any shutdowns and must be easily replaceable in case of damage. ■ Wall panelling and Ceiling tiles must be a combination of perforated and nonperforated tiles to have Sound absorption coefficient (NRC) value as per ISO:82251987, ISO: 354-2003. Panelling to be 100% Modular self inter lockable metal panels of Preformed textured Hot dip galvanized strips and sheets of low carbon steel coated on one side with rigid polyvinylchloride (PVC) film and on the other side a coating based on cross linkable polyester resins (sheet thickness 0.6mm & PVC Coating 0.15mm). ■ Wall Panelling and Ceiling must be seismically tested & certified for Zone 3(Chennai) Vibrations. Control Room Interiors must be free from health hazardous substances because of interior finishes. ■ Wall Panelling and Ceiling tiles must be Class A fire rated certified for surface burning characteristics and ROHS certified from to ensure restriction of hazardous substance in any of the materials. This is mandatory to ensure that the materials used in the interiors do not provoke fire. ■ It is imperative that the control centres are designed properly in terms of Aesthetics, Ergonomics and Functionality and should be designed as per ISO 11064 norms. Various aspects should be considered while designing to create ideal workplace, considering physiological aspects such as line of sight, field of vision and cognitive factors such as concentration and perceptivity as per ISO 11064. ■ False floor: Top of the flooring shall be similar to the Acoustic Flooring. The acoustic laminate should be made up of twin-layer linoleum built up from 2mm Laminate. The Panel should <ul style="list-style-type: none"> a) Have density of 1600KgM3. b) Fire resistance DIN EN 1366-6 2005-02. c) Core material thickness should be minimum 30mm

	<ul style="list-style-type: none"> ■ False floor panels shall rest on edge support rigid grid system having Galvanized Iron base plate dimensions as 100mm X 100mm. The stringer should be fixed on pedestal having height adjustment of ± 25mm. ■ To avoid distraction of operators because of unwanted noise generated from movement of chairs/people in the control room it is necessary that the proposed flooring shall damp such impact noises. The decorative acoustic flooring shall reduce impact sound by 14dB (ISO 717-2)). It shall be twin-layer linoleum built up from 2mm acoustic laminate and 2mm Corkment backing. ■ Paneling/cladding tiles shall be designed to achieve shape and design as per the design consultant. To enhance the aesthetic, appeal the control room interior solution provider must include diffused & concealed light elements in the control room wall paneling. These illumination elements must have provision of for quick & easy installation & maintenance. These concealed lights shall have RGB combination and shall be controlled through a touch screen mounted on the supervisor/main control desk. Various light colors like blue for VIP visit, green for normal operations and red for emergency shall indicate different control room scenarios and shall have additional customizations also. Control room ceiling shall also feature same illuminated strip on the periphery. The ceiling strip shall be in sync with the paneling light strip.
Furniture and Fixture	
2.	<ul style="list-style-type: none"> ■ Workstation size of min. 20" depth made with 1.5 mm thick laminate of standard make over 20 mm thick commercial board complete with wooden beading waterproof including cutting holes & fixing of cable manager etc. complete with French polish. Edges shall be factory post-formed. The desk shall have the necessary drawers, keyboard trays, cabinets etc. along with sliding / opening as per approved design with quality hydraulic drawer slides, hinges, locks etc. ■ Storage unit with 20 mm thick MDF board along with 1.5 mm approved laminate colour outside and 2 coat of enamel paint inside the storage of size 1'6"x1'6"x2'4". The same should be provided with all the required accessories including the handle, lock, sliding channel and necessary hardware, etc. complete with French polish ■ Cabin table of min. Depth 36" made with 1.5 mm thick laminate of standard make over 20mm thick commercial board complete with wooden beading including cutting holes & fixing of cable manager etc. complete with French polish. ■ 6" high laminated strip using 1.5 mm thick laminate over 10mm thick commercial board on all vertical surface in the entire server & ancillary areas including low height partition, brick wall, partition wall, cladding etc. complete with French polish in all respect. ■ Enclosure for gas cylinder of Shutters and Partitions along with wooden support and 24 mm thick MDF board along with 2.0 mm approved laminate colour outside and 2 coat of enamel paint inside the shutter and water resistance. The same should be provided with all the required accessories including the handle, lock, loaded hinges, tower bolt and necessary hardware etc. complete with French polish. ■ The Contractor shall be supply and maintain entire required furniture for TIMS -CCC. The design and specification shall be shared by the Contractor with Engineer for quality approval in later stage. Quantity can be change on recommended deign of TIMS -CCC . ■ Chair shall be good enough and comfortable for long siting with hand rest.
Partitions (wherever required as per design and approved drawing by Engineer)	
3.	<ul style="list-style-type: none"> ■ Full height partition wall of 125 mm thick fire line gyp-board partition using 12.5 mm thick double fire line gyp-board on both sides with GI steel metal vertical stud frame of size 75 mm fixed in the floor and ceiling channels of 75 mm wide to provide a strong partition. Glass wool insulation inside shall be provided as required. Fixing is by self-tapping screw with vertical studs being at 610 mm intervals. The same should be inclusive of making cut-outs for switch board, sockets, grill etc. It shall also include preparing the surface smoothly and all as per manufacture's specification etc. finally finishing with one coat of approved brand of fire-resistant coating.

	<ul style="list-style-type: none"> ■ With glazing including the framework of 4" x 2" powder coated aluminum section complete (in areas like partition between server room & other auxiliary areas). ■ Fire Rated Wire Glass minimum 6 mm thick for all glazing in the partition wall complete. (External windows not included in this). ■ All doors should be minimum 1200 mm (4 ft.) wide.
Painting	
4.	<ul style="list-style-type: none"> ■ Fire retardant paint of pre-approved make and shade to give an even shade over a primer coat as per manufacturers' recommendations after applying painting putty to level and plumb and finishing with 2 coats of fire-retardant paint. Base coating shall be as per manufacturer's recommendation for coverage of paint. ■ For all vertical Plain surface. ■ For fire-line gyp-board ceiling. ■ POP punning over cement plaster in perfect line and level with thickness of 10 – 12 mm including making good chases, grooves, edge banding, scaffolding pockets etc. ■ Fire retardant coating on all vertical surfaces, furniture etc. as per manufacturer's specification.
PVC Conduit	
5.	<ul style="list-style-type: none"> ■ The conduits for all systems shall be high impact rigid PVC heavy-duty type and shall comply with I.E.E regulations for standardized conduit 1.6 mm thick as per IS 9537/1983. ■ All sections of conduit and relevant boxes shall be properly cleaned and glued using appropriate epoxy resin glue and the proper connecting pieces, like conduit fittings such as Mild Steel and should be so installed that they can remain accessible for existing cable or the installing of the additional cables. ■ No conduit less than 20mm external diameter shall be used. Conduit runs shall be so arranged that the cables connected to separate main circuits shall be enclosed in separate conduits, and that all lead and return wire of each circuit shall be run to the same circuit. ■ All conduits shall be smooth in bore, true in size and all ends where conduits are cut shall be carefully made true and all sharp edges trimmed. All joints between lengths of conduit or between conduit and fittings boxes shall be pushed firmly together and glued properly. ■ Cables shall not be drawn into conduits until the conduit system is erected, firmly fixed and cleaned out. Not more than two right angle bends or the equivalent shall be permitted between draw or junction boxes. Bending radius shall comply with I.E.E regulations for PVC pipes. ■ Conduit concealed in the ceiling slab shall run parallel to walls and beams and conduit concealed in the walls shall run vertical or horizontal. ■ The chase in the wall required in the recessed conduit system shall be neatly made and shall be of angle dimensions to permit the conduit to be fixed in the manner desired. Conduit in chase shall be hold by steel hooks of approved design of 60cm center the chases shall be filled up neatly after erection of conduit and brought to the original finish of the wall with cement concrete mixture 1:3:6 using 6mm thick stone aggregate and coarse sand. ■ Cable Trays and Wiring: - The desks must be designed with vertical and horizontal cable trays to allow for continuous cable management between the cabinets. Wire shall be routed into the cabinet through gland plate. Proposed console should be RoHS Certified from UL/Intertek and the valid certificate must be submitted along with the bid.

6 Building Utilities Requirements

Table 6-1: Building utilities requirement of Control room and Datacentre

No.	Requirement
	Access Control System
1	<ul style="list-style-type: none"> ■ The Contractor shall implement Access Control System for the floor of the control center with the objective of allowing entry and exit to and from the premises to authorized personnel only. The system deployed shall be based on Biometric Technology as well as face detection with optional proximity card function.. An access control system consisting of a central PC, intelligent controllers, power supplies and all associated accessories is required to make a fully operational online access control system. Access control shall be provided for entry & exit doors. These doors shall be provided with electric locks and shall operate on fail-safe principle. ■ The lock shall remain unlocked in the event of a fire alarm or in the event of a power failure. The fire alarm supplier shall make potential free contacts available for releasing the locks in a fire condition especially for staircase and main doors ■ The Contractor shall ensure all the entry and exit shall be restricted and accessible only through authorize access medium apart emergency. ■ The Contractor shall supply, install and commissioning access control system with integration BAS. Access control system shall be centralized and shall have following type input and output as per quantity required for TMS Control Centre: <ul style="list-style-type: none"> ✓ Universal Inputs ✓ Reader Inputs ✓ Tamper Input ✓ Digital Lock Output ■ The system shall monitor the status of the doors through magnetic reed contacts, but main entrance shall be primary level through face detection. The system should be designed and implemented to provide following functionality: <ul style="list-style-type: none"> ✓ Controlled Entries to defined access points ✓ Controlled exits from defined access points ✓ Controlled entries and exits for visitors are non-restricted area ✓ Configurable system for user defined access policy for each access point ✓ Record, report and archive each activity (permission granted and / or rejected) for each access point. ✓ User defined reporting and log formats ✓ Fail safe operation in case of no-power condition and abnormal condition such as fire, theft, intrusion, loss of access control, etc. ✓ Day, Date, Time and duration-based access rights should be user configurable for each access point and for each user. ✓ On based on user access rights for different access points. ✓ The Access Controller should also support the SNMP alarming option.
	Fire & Smoke Detection System
2	<ul style="list-style-type: none"> ■ The Contractor shall supply, install and commissioning of suitable Fire & smoke detection system. Fire can have disastrous consequences and affect operations of a Control Room. It is required that there is early detection of fire for effective functioning of the Control Room. ■ The system shall have zone configuration functionality as per suggest layout of CCC in previous chapter with minimum define function option but not limited. <ul style="list-style-type: none"> ✓ Zone single loop addressable fire detection and alarm system, utilizing conventional detection and alarm sounders. ✓ Detection shall be by means of automatic heat and smoke detectors located throughout the Control Room (ceiling, false floor and other appropriate areas where fire can take place) with break glass units on escape routes and exits. ✓ Smoke detectors ✓ High Sensitivity Smoke Detection System ✓ Manual Controls

	<ul style="list-style-type: none"> ✓ Heat detectors ✓ Audible Alarms <p>■ The Contractor shall be ensuring and submit required certification CIE conforming to the requirements of EN54 Part 7, EN54 Part 5, NEC, Local body Authorize and be LPCB approved</p> <p>Specification</p> <ul style="list-style-type: none"> i. Control & Monitor module must be provided for integration with 3rd party systems. ii. The System shall consist of a highly sensitive LASER-based smoke detector, aspirator, and filter. iii. It shall have a display featuring LEDs and Reset/Isolate button. The system shall be configured by a programmer that is either integral to the system, portable or PC based. iv. The system shall allow programming of: <ul style="list-style-type: none"> ✓ Multiple Smoke Threshold Alarm Levels. ✓ Time Delays. ✓ Faults including airflow, detector, power, filter block and network as well as an indication of the urgency of the fault. ✓ Configurable relay outputs for remote indication of alarm and fault Conditions. v. It shall consist of an air sampling pipe network to transport air to the detection system, supported by calculations from a computer-based design modelling tool. vi. Optional equipment may include intelligent remote displays and/or a high-level interface with the building fire alarm system, or a dedicated System Management graphics package. vii. Shall provide very early smoke detection and provide multiple output levels corresponding to Alert, Action, Fire 1 & 2. These levels shall be programmable and shall be able to set sensitivities ranging from 0.025 – 20% obscuration / meter.
CCTV surveillance at TIMS Control Centre	
3	<p>■ The Contractor must supply, installation, commissioning, and maintenance of appropriate CCTV system to monitor activity in TIMS-CCC related for CITS Project Facilities such as server room, UPS Room, inventory Room etc</p> <ul style="list-style-type: none"> ✓ Fixed Dome Camera ✓ Fixed Bullet Camera ✓ Fisheye Camera ✓ NVR With 42" Monitor ✓ Storage Capacity minimum 4 months ✓ 5 MP or better
PA System	
4	<p>■ The Contractor must supply, install, commissioning, and maintenance of appropriate PA system for announcements in the control center. The supplied PA system for the control system shall be a combination of the following equipment but not limited:</p> <ul style="list-style-type: none"> ✓ Audio Mixer & Speaker System ✓ Speaker shall be installed on fall ceiling or wall mounted ✓ The number of speakers shall be sufficient in Each room of TIMS CCC as the desired capacity of the speaker system is required. ✓ The conference room shall have a sufficient number of Micro Phone to cover the entire requirement. ✓ Microphones and other accessories shall be install as required on the other desk of the operator, maintenance staff for successful operation. ✓ Auto Echo cancellation feature shall be inbuilt ✓ Should have the capability to control individual PAS i.e. to announce select location (1:1) and all locations (1: many) simultaneously. The PAS should also support both, Live and Recorded inputs. ✓ Minimum 10 speakers, to be used for Public Address System ✓ Communication shall be over IP
Lighting	
5	<p>■ The Contractor must supply, installation, commissioning, and maintenance of appropriate LED based lighting system both recessed direct and indirect lighting for TIMS -CCC. The supplied led lights shall be overhead and have following define function bear minimum.</p>

	<ul style="list-style-type: none"> ✓ Lighting Intensity – All the lights shall be maintaining required LUX as per “Layout” ✓ Dimming Feature – Proposed Lighting system shall have dimming feature (Sunny, Cloudy, partial cloudy night etc.) and connected with BAS. ✓ Quality- The light system shall be configuring in such manner that reflection will not impact on monitor and video wall. <p>■ To avoid dark spots/areas in the control room it is necessary that continuous linear lights are used across the width/length of the control room. UL audit certified design feature of integrated channel in ceiling for quick installation & replaceability of continuous linear light: The ceiling system having integrated inbuilt channel for installation of cove lights and shall permit quick and easy replacement of cove light without using any tools. Valid UL audit Certificate to be submitted along with the technical bid.</p>
DG Set	
6	<p>■ The Contractor shall consider the load for TIMS equipment, 100% Air condition sizing and minimum lighting requirement inside CCC room only.</p> <p>■ The Contractor must supply, installation, commissioning and maintenance of appropriate DG set to operate TIMS-CCC in case of power failure. DG set shall be capable infought to cover entire load of electrical consumption of control center in case of disaster.</p> <p>■ DG set shall relate to automation system and automated to operate as well as monitor statics. The Contractor shall submit a load calculation sheet for TIMS-CCC with 15 % access load variation before supply for consultation and approval to consent authority.</p> <p>■ Scope can be change in future due to space allotment in new building later stage on behalf of discussion with the Employer.</p>
Precision Air-condition	
7	<p>■ The Contractor shall be supply, installation, commissioning, and maintenance of required capacity according to define layout of CCC in previous section “Layout”.</p> <p>The Precision AC technology shall be standard, durable, and latest according to requirement of “Layout”.</p> <p>■ The Employer planning for new building and they will assign semi-furnished or furnished space for TIMS CCC and the Contractor shall shift the TIMS CCC in the newly assigned location and space without any further cost obligation to the Employer and the Contractor shall submit the details for the shifting to the Engineer and Employer for further approval of work plan and measures in order to maintain the functioning of the TIMS Systems at the optimum level.</p> <p>Precision AC Minimum Specification</p> <ul style="list-style-type: none"> ✓ Cooling Capacity as per the requirements at each of the control rooms ✓ Compressor – Hermetically Sealed Scroll Type ✓ Refrigerant – R 32 Type ✓ Power Supply – Three Phase/Two Phase, 380-415 V, 50 Hz ✓ Air Flow Rate – minimum 19 cu m / min ✓ Noise Level - < 50 dB ✓ Operation – Remote Control
Fireproof	
8	<p>■ The Contractor must install and implement fireproof safe at TIMS-CCC. The safe should be suitable for safe storage of computer diskettes, tapes, smart cards and similar devices and other magnetic media, paper documents, etc. The safe should have adequate fire protection.</p>
Rodent Repellent	
9	<p>■ The entry of Rodents and other unwanted pests shall be controlled using non-chemical, non-toxic devices. Ultrasonic pest repellents shall be provided in the false flooring and ceiling to repel the pests without killing them. However periodic pest control using Chemical spray shall be done on regular interval as a contingency measure to effectively fight the pest menace.</p>
Provision for Sanitization	
10	<p>The Contractor shall supply, Install, and maintain the guidelines of WHO /Indian health organization for automatic sanitization and automatic body temperature detection or any other guidelines issues by Government time to time for any health hazard.</p>

7 Functional Requirements

7.1 System Server Architecture

The central server system shall constantly monitor the operation of component systems and their subsystems. It shall be possible through the supervisory server to define/ modify the system configuration and add/remove any device connected to one of the component systems. It shall also be possible to change any system parameters defined and stored in the database.

Provision shall be made with preventive measures against inadequate change to the system parameters. Access to the system configuration function must be restricted to the authorized personnel and error check function shall be incorporated as much as possible. The configuration and parameters of the system shall be backed up to allow recovery. Seamless data exchange (including incident/event management/ monitoring, video streaming of all cameras, access to reporting modules, facility management system, NMS etc.).

- To minimize the system downtime and make the System effective, central system servers shall be established on premises with redundant architecture (hot and standby).
- In case that the Command Control Centre will be affected by disasters, essential central system servers shall be established on cloud as well to maintain the necessary operations in such situation.
- Primary and secondary on-premises system servers for TIMS and CBS shall be implemented by server virtualization technologies.
- For backup cloud-based system servers shall be higher availability and non-failure configuration.
- The primary and secondary server, cloud-based server shall exchange replication backup data to manage the Fail-out.

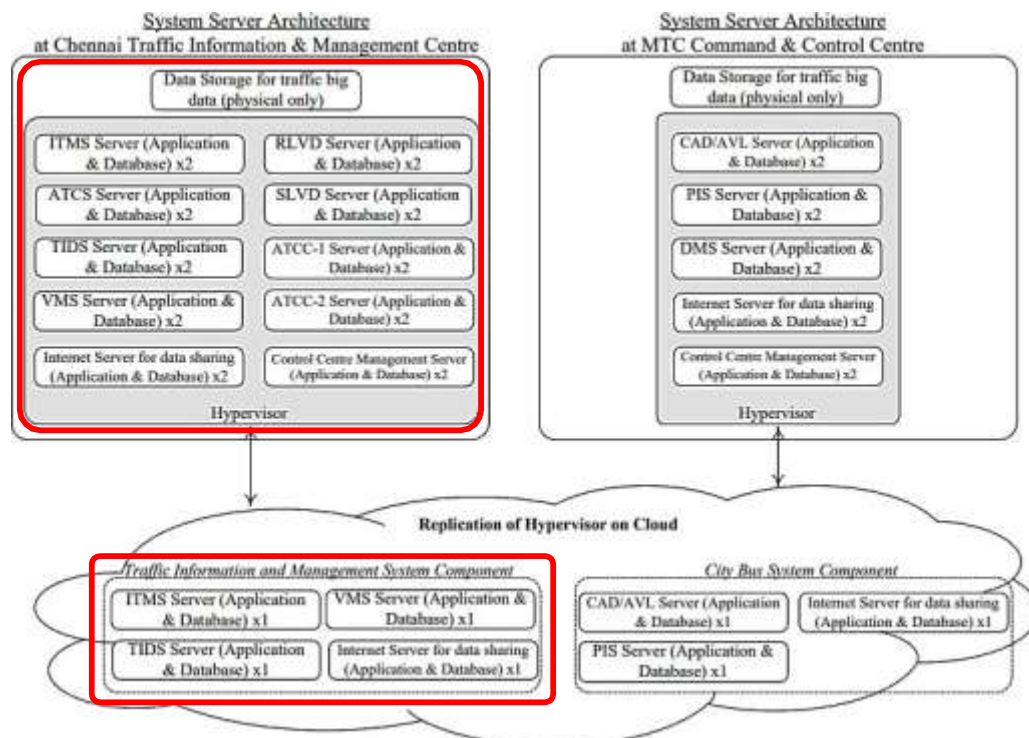


Figure 7-1: System Server Architecture for the System

Table 7-1: Functional requirement of System server architecture

No.	Requirements
General	
Server Virtualization for Primary and Secondary Servers	
1.	<ul style="list-style-type: none"> ■ Virtualization software should be bare metal hypervisor with functionality of High Availability, Complete Availability, hot Add (CPU, Memory, Storage & Network), dynamic resource scheduler, Centralized distributed switch proven features. ■ Virtualization software should support live Virtual Machine migration between different generations of CPUs in the same cluster and without the need for shared storage option. ■ Virtualization software shall provide a Virtualization layer that sits directly on the bare metal server hardware with no dependence on a general-purpose OS ■ Ability to present more memory to virtual machines than physically available by dynamically (re)allocating memory to virtual machines when needed/reclaiming it when not needed to maximize consolidation ratios ■ Virtualization software should provide integration of 3rd party endpoint security to secure the virtual machines with offloaded antivirus, anti-malware solutions without the need for agents inside the virtual machines. ■ The Solution should have tight integration and management framework that virtualizes SAN/NAS arrays. ■ Provide granular VM-Centric controls, automated self-rebalancing capabilities to align with defined Storage service levels ■ Provide Interactive topology maps to visualize the relationships between physical servers, virtual machines, networks and storage. ■ The solution should offer automated orchestration of site failover and failback with a single-click to reduce recovery times. ■ The solution should offer Centralized management of recovery plans from the virtualization manager console replacing the manual runbooks both DC and DR ■ The solution should offer frequent, non- disruptive testing of recovery plans to ensure highly predictable recovery objectives. ■ The solution shall provide prebuilt & customizable operations dashboards & reports to provide real-time insight into infrastructure behavior, upcoming problems and opportunities for efficiency improvements ■ The solution should provide capacity analytics to do "What If" scenarios such as Project planning to identify the resource shortfall and do Capacity Planning for Future workload requirements. ■ The solution should offer planned migration workflow to enable disaster avoidance and data center mobility. ■ The solution should provide a log analytical tool which will collect data from various data Sources ■ The solution shall provide the ability to identify and report on over-sized, under- sized, idle and powered-off virtual machine such that the environment can be right-sized, and resources can be reclaimed
Cloud Server for Backup Servers	
2.	<ul style="list-style-type: none"> ■ If the Contractor chooses the cloud as backup server then the eligible cloud service providers (CSPs) shall be Ministry of Electronics & Information Technology (MeitY) empaneled CSPs as per the Guidelines for Procurement of Cloud Services (MeitY). ■ End-to-end firewall, email and web security, intrusion protection, and event and log management around the clock, 365 days a year. Managed host-based intrusion detection system to prevent malware from infecting your virtual servers. Emergency response services when a cloud breach is suspected.

7.2 Disaster Recovery

Table 7-2: Functional requirement of Disaster recovery

No.	Requirements
General	
1	<ul style="list-style-type: none">■ The Contractor shall propose the suitable disaster recovery plan for the System.■ The minimum following three (3) servers of Traffic Information and Management System which will be critical for operation at a time of disaster shall be protected by replicating them on cloud. <p>(1) Integrated Traffic Management System Server (Application and Database) to monitor the road and traffic situation / to provide the traffic information to road users / share the traffic information to related agencies at time of disaster.</p> <p>(2) Traffic Incident Detection System Server (Application and Database) to monitor the road and traffic situation at time of disaster.</p> <p>(3) Variable Message Sign Server (Application and Database) to provide the traffic information to road users at time of disaster.</p> <p>(4) Adaptive Traffic Signal Control System Server (Application and Database) to manage traffic signal system for road users at time of disaster.</p> <p>(5) RLVD System Server (Application and Database) to manage RLVD system for road users at time of disaster.</p> <p>(6) SLVD System Server (Application and Database) to manage SLVD system for road users at time of disaster.</p> <p>(7) ATCC System Server (Application and Database) to manage ATCC system for road users at time of disaster.</p>
Replication Method	
2.	<ul style="list-style-type: none">■ The Contractor shall propose the suitable replication method for the System.■ Host based replication will be preferable for the data replication.■ The traffic big data analytics.
Recovery Time Objective (RTO) / Recovery Point Objective (RPO)	
3.	<ul style="list-style-type: none">■ Recovery Time Objective (RTO) shall be less than 24.0 hours■ Recovery Point Objective (RPO) shall be less than 24.0 hours

7.3 Long Term Data Archive

In order to utilize the traffic big data for various usage such as future road planning, data exchange etc. the System shall archive the historical traffic data and other necessary information as required by the Employer time to time.

The Contractor shall propose effective data archive method and system.

Table 7-3: Functional requirement of Long term data archive

No.	Requirements
General	

1	<ul style="list-style-type: none">■ Large data collected and generated from ITMS application provides an information to authorities and planning organizations to understand baseline conditions, evaluate the impact of changes to road policy, road infrastructure or travel demands over time. Such large data shall be protected and available for a long period of time.■ The minimum items to be permanently archived into the physical data storage are shown below. The data shall be moved to external storage periodically (once in a week/month at least defined during design stage) by the O&M Contractor for a backup. The Contractor is free to propose effective data archive methods and include them in their O&M plan. <ol style="list-style-type: none">(1) Traffic Data collected by ATCC 2 (Traffic classification data)(2) Traffic Data processed by Probe System (Link based/section-based traffic data)(3) Registered Incident Data (Incident type, location, time etc.)(4) Displayed Data on VMS
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	(5) Important system log data for system adjustment
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7.4 Security

Table 7-4: Functional requirement of Security

Requirements
Security requirement <ul style="list-style-type: none"> ■ For Control Center End point security is essential to any device that is physically an end point on a network. Laptops, desktops, mobile phones, tablets, servers can all be termed as endpoints. ■ Endpoint security refers to cybersecurity services for network endpoints. These services include antivirus, email filtering, web filtering, and firewall services. Endpoint security plays a crucial role for businesses, ensuring critical systems, intellectual property, customer data, employees, and guests are protected from ransomware, phishing, malware, and other cyberattacks. ■ Endpoint Service Features <ul style="list-style-type: none"> ✓ Anti-virus - Smart Scan leverages anti-malware and antispyware signatures stored in-the-cloud ✓ Anti-spyware - Conventional Scan leverages anti-malware and antispyware components stored locally on Security Agents ✓ Application Control (Win PC) - Create rules to restrict the applications that can execute or install on the endpoints. ✓ Behavior Monitoring Incl. Ransomware Protection (Win PC only) - Behavior Monitoring protects endpoints from unauthorized changes to the operating system, registry entries, other software, or files and folders. Protect documents against unauthorized encryption or modification, automatically back-up and restore files changed by suspicious programs, Block processes commonly associated with ransomware, enable program inspection to detect and block compromised executable files ■ Endpoint Sensor ■ Firewall (Win PC) - The firewall can block or allow certain types of network traffic by creating a barrier between the endpoint and the network ■ Full Disk Encryption ■ HTTPS Web Threat Protection ■ Predictive Machine Learning ■ Role-based Administration ■ Unauthorized Change Prevention Service (Win PCs only) - Regulates application behavior and validates program trustworthiness. ■ URL Filtering - URL Filtering allows administrators to block specific types of websites during different times of the day. ■ Industry leading protection from Virus, Spyware, Phishing and Hacking. URL filtering. USB Port Blocking. Data Theft prevention ■ Web Reputation enhances protection against malicious websites. ■ Physical or virtual network appliance that monitors 360 degrees of network to create complete visibility into all aspects of targeted attacks, advanced threats, and ransomware. ■ Prevent assess potential vulnerabilities and proactively protect endpoints, servers, and applications. Detect advanced malware, behavior, and communications invisible to standard defenses. Enable rapid response through shared threat intelligence and delivery of real-time security updates. Must gain centralized visibility across the network and systems; analyze and assess the impact of threats. ■ Ability to scan through all file types and various compression formats. Ability to scan HTML, VBScript Viruses, malicious applets and ActiveX controls. Able to update itself over internet for virus definitions, program updates etc. (periodically as well as in push-updates in case of outbreaks). ■ Able to perform different scan Actions based on the virus type (Trojan/ Worm, Joke, Hoax,

	Requirements
	Virus, other). Provides Real-time Product Performance Monitor, Built-in Debug and Diagnostic tools, and context – sensitive help. The solution provides protection to multiple remote clients. Provides for virus notification options for Virus Outbreak Alert and other configurable conditional Notification. Capable of providing multiple layers of defense. Facility to clean, delete and quarantine files affected with virus. Supports online update, whereby most product updates and patches can be performed without bringing messaging server off-line.

7.5 Video Wall Management Software

Table 7-5: Functional requirement of Video wall management software

No	Items	Requirements
1.	Display &Scaling	At least 20 layers
2.	Input Management	All input sources can be displayed on the video wall in freely resizable and movable windows
3.	Scenarios management	Save and load desktop layouts from local or remote machines
4.	Layout Management	Support all layout from input sources, Internet Explorer, desktop and remote desktop application
5.	Multi-View Option	Multiple views of portions or regions of Desktop, multiple applications can view from a single desktop
6.	Other features	SMTP support
7.		Remote Control over LAN
8.		Alarm management
9.		Remote management
10.		Multiple concurrent clients
11.		KVM support

8 Hardware Requirement

All hardware equipment shall as a minimum, meet all the requirements listed in the specifications. The equipment's provided shall accommodate to future technological advances which exceeds the minimum requirements provided in the specifications.

8.1 Servers

Table 8-1: Hardware requirement of Servers

No.	Items	Requirements
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1	General	<ul style="list-style-type: none">■ Minimum 6U size, rack-mountable, capable of accommodating minimum 8 or higher hot-pluggable blades■ Have the capability for installing industry-standard flavors of Microsoft Windows, and Enterprise RedHat Linux OS as well as virtualization solutions such as VMware.■ DVD ROM shall be available in chassis, can be internal or external, which can be shared by all the blades allowing remote installation of software
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No.	Items	Requirements
		<ul style="list-style-type: none">■ Minimum 1 USB port
2	Processor	<ul style="list-style-type: none">■ Latest series/ generation of 64-bit x86 processor(s) with Ten or higher Cores■ Processor speed should be a minimum of 2.4 GHz■ Minimum 2 processors per physical server
3	RAM	Min. 24 DIMM slots, should be provided with 256 GB RAM using DDR4 DIMM's operating at 2666 MT/s (depending on processor model)
4	Internal Storage	2 x 400 GB SAS (10k rpm) hot swap disk with extensible bays
5	Network interface	2 X 20GbE LAN ports for providing Ethernet connectivity Optional: 1 X Dual-port 16Gbps FC HBA for providing FC connectivity
6	Power supply	Dual Redundant Power Supply
7	RAID support	As per requirement/solution
8	Operating System	The licensed version of 64 bit latest version of Linux/ Unix/Microsoft® Windows-based Operating system
9	Form Factor	Rack mountable/ Blade
10	Virtualization	Shall support Industry-standard virtualization hypervisors like Hyper-V, VMWARE, and Citrix.
11	Storage controller	SAS Raid Controller with RAID 0/1
12	Bus Slots	Minimum of 2 Nos of PCIe 3.0 based mezzanine slots supporting Converged Ethernet adapters
13	Motherboard	Intel Chipset compatible with the offered processor
14	Interfaces	Minimum of 1 Internal USB 3.0 port, 1 Internal SD Card Slot
15	Redundancy	Must have port level and card level redundancy
16	Operating System & Virtualization Support	<ul style="list-style-type: none">■ Microsoft Windows Server (latest version)■ Red Hat Enterprise Linux (RHEL) (latest version)■ SUSE Linux Enterprise Server (latest version)■ VMware / feature-rich virtualization software supporting solution design & stack
17	Warranty	5 Year OEM Warranty

8.2 Workstation (3 monitors)

Table 8-2: Hardware Requirement of Workstation (3 monitors)

No.	Item	Requirements
1.	General	<ul style="list-style-type: none">■ Operator Console shall enable operators to use applications of each TIMS component■ Workstation manufactured by internationally reputed organization (OEM)■ 5 years hardware supporting warranty with Next Business Day Onsite Service■ Readily available in India■ Space saving type enclosure■ Low energy consumption
2.	Processor	<ul style="list-style-type: none">■ Intel Xeon processor (4core) 4.1GHz / 4.6GHz, cache 8MB or better
3.	OS	<ul style="list-style-type: none">■ Latest Windows operating system or compatible OS with the server OS.
4.	Memory	<ul style="list-style-type: none">■ 64GB ECC 4x16GB DDR4 2933MHz RDIMM ECC Memory
5.	Storage	<ul style="list-style-type: none">■ Intel Integrated controller (RST-e) with 1-2 Front FlexBay NVMe PCIe Drives■ M.2 256GB PCIe NVMe, Solid State Drive■ 2.5" 256GB SATA Solid State Drive or better
6.	Graphic card	<ul style="list-style-type: none">■ NVIDIA GEFORCE RTX 3070, 8GB, 4DP■ AMD Radeon Pro W5500, 8GB, 4 DP
7.	Display ports	<ul style="list-style-type: none">■ 1 VGA, 2 Displays Ports, 1 HDMI / compatible display ports
8.	GPU	<ul style="list-style-type: none">■ Base clock: 1290 MHz or better■ Number of cores: 768 or better■ VRAM: 4GB or better■ Display connectors: DP 1.4, HDMI 2.0b, dual link-DVI multimonitor support■ Max resolution: 7680 x 4320 @ 60 Hz or better
9.	Console Display Monitor	<ul style="list-style-type: none">■ 3 monitors■ Three monitors that are 21-inch or more size of LCD type widescreen monitor (Full HD or UHD – 60 Hz refresh rate)■ Aspect Ratio – 16:9■ Resolution 2560x1440■ Brightness 300cd/m2■ RGB Analogue, DVI-D or HMDI required as input interface, 1 HDMI Display Port■ Picture-by-Picture view 2 different input sources on one screen that should be same as of video interface.■ Or IP based Monitors
10.	Peripheral	<ul style="list-style-type: none">■ 16x DVD R/W
11.	Keyboard	<ul style="list-style-type: none">■ Wired keyboard with 104 keys or wireless
12.	Mouse	<ul style="list-style-type: none">■ Wired Optical with USB interface or wireless
13.	Ports	<ul style="list-style-type: none">■ USB Ports including 2 USB 3.0 Ports and audio ports for microphone and headphone
14.	Cabinet	<ul style="list-style-type: none">■ Mini Tower
15.	Network	<ul style="list-style-type: none">■ 1000/100M Base LAN interface■ Wireless 802.11 a/b/g/n/ac or better

No.	Item	Requirements
16.	Security	<ul style="list-style-type: none"> ■ Virus protection
17.	Reliability	<ul style="list-style-type: none"> ■ MTBF > 3 years x 365 days x 24 hours = 26,280 hours ■ MTTR < 24 hours ■ Monitoring temperature of CPU & inside casing, HD status. ■ Alerting function when faults. ■ Latest SNMP supporting
18.	Power Consumption	<ul style="list-style-type: none"> ■ AC230V, 950W or better

8.3 Workstation (1 monitor)

Table 8-3: Hardware Requirement of Workstation (1 monitor)

No.	Item	Requirements
1.	General	<ul style="list-style-type: none"> ■ Operator Console shall enable operators to Technical support team, Call center team etc. ■ Workstation manufactured by internationally reputed organization ■ 5 years hardware supporting warranty ■ Readily available in India ■ Space saving type enclosure ■ Low energy consumption
2.	Processor	<ul style="list-style-type: none"> ■ Intel Xeon processor (4core) 3.0GHz, cache 8MB or better
3.	OS	<ul style="list-style-type: none"> ■ Latest Windows operating system or compatible OS with the server OS.
4.	Memory	<ul style="list-style-type: none"> ■ 8GB ECC DDR4 or better
5.	Storage	<ul style="list-style-type: none"> ■ 512 GB SSD or better
6.	Graphic card	<ul style="list-style-type: none"> ■ NVIDIA GeForce GTX 745 or better
7.	Console Display Monitor	<ul style="list-style-type: none"> ■ Professional or Flat Model ■ 21-inch or more size of LCD type ■ widescreen monitor (Full HD or UHD – 60 Hz refresh rate) ■ Aspect Ratio – 16:9 ■ Resolution 2560x1440 ■ Brightness 300cd/m2 ■ RGB Analogue, DVI-D or HDMI required as input interface, 1 HDMI Display Port ■ Picture-by-Picture view 2 different input sources on one screen that should be same as of video interface. ■ Or IP based Monitors
8.	Display ports	<ul style="list-style-type: none"> ■ 1 VGA, 2 Displays Ports, 1 HDMI
9.	GPU	<ul style="list-style-type: none"> ■ Base clock: 1290 Mhz or better ■ Number of cores: 768 or better ■ VRAM: 4GB or better ■ Display connectors: DP 1.4, HDMI 2.0b, dual link-DVI multimonitor support ■ Max resolution: 7680 x 4320 @ 60 Hz or better
10.	Peripheral	<ul style="list-style-type: none"> ■ 16x DVD R/W
11.	Keyboard	<ul style="list-style-type: none"> ■ Wired keyboard with 104 keys or wireless

No.	Item	Requirements
12.	Mouse	■ Wired Optical with USB interface or wireless
13.	Ports	■ USB Ports including 2 USB 3.0 Ports and audio ports for microphone and headphone
14.	Cabinet	■ Mini Tower
15.	Network	■ 1000/100M Base LAN interface
16.	Security	■ Virus protection
17.	Reliability	■ MTBF > 3 years x 365 days x 24 hours = 26,280 hours ■ MTTR < 24 hours ■ Monitoring temperature of CPU & inside casing, HD status. ■ Alerting function when faults. ■ Latest SNMP supporting
18.	Power Consumption	■ AC230V, 700 W or better

8.4 Call Centre Terminal

Table 8-4: Hardware requirement of Call centre Terminal

No	Item	Requirements
1	Processor	Latest Quad Core i9 with 3 GHz or higher
2	OS	Latest Windows operating system or compatible OS with the server OS.
3	Memory	Minimum 8 GB DDR3 or higher expandable up to 32 GB or more
4	Storage	2 TB SATA-3 Hard drive @7200 rpm with Flash Cache of 64GB SSD. Provision for installing 4 more drives.
5	Graphics card	Minimum Graphics card with 2 GB video memory (non-shared)
6	Console Display Monitor	One monitor of 27" TFT LED monitor, Minimum 1920 x1080 resolution, 5 ms or better response time
7.	PORT	1 HDMI port (Preferable), 2x USB 2.0 and 2 x USB 3.0 (Preferable), 10 USB ports external - with minimum 4 ports USB 3.0 Front I/O includes (2 or more) USB 2.0 ports Rear I/O includes (2 or more) USB 3.0 ports, (2 or more) USB 2.0 ports, serial port, Parallel port, PS 2 mouse and keyboard ports, RJ-45 network interface, Display Port 1 VGA and 3.5mm audio in /out jacks; 4 in 1 Media Card Reader Preferable)
8	Certification	Energy star /BEE certified/EPEAT
9.	GPU	Base clock: 1290 Mhz or better Number of cores: 768 or better VRAM: 4GB or better Display connectors: DP 1.4, HDMI 2.0b, dual link-DVI multimonitor support Max resolution: 7680 x 4320 @ 60 Hz or better
10.	Peripheral	No-CD /DVD Drive
11.	Keyboard	Wired keyboard with 107 keys or wireless
12.	Mouse	2 Or 3 button USB Optical Scroll Mouse with antistatic mouse pad resolution of Optical 1000 CPI, Complying to CE and FCC norms
14.	Cabinet	Mini Tower
15.	Network	10/100/1000 Mbps autosensing onboard integrated RJ-45 Ethernet port.

16	Security	BIOS controlled electro-mechanical internal chassis lock for the system.
17	Power Consumption	AC230V, 700 W or better

8.5 Video Wall

Forty-Eight (48) cubes of DLP Laser or LED light source shall be used as Video Wall. The size of each display shall be 70 inches. The Video Wall shall be arranged in Eight (8) unit by Six (6) unit configurations (Eight (8) column wise and Six (6) row wise). Assemble the video wall using a dedicated wall kit.

Connection between video sources and video wall shall be flexible and it shall be possible to assign a video source to one or multiple monitors. Malfunction of an individual DLP Cube unit shall not prevent normal operation of other DLP Cube units.

Table 8-5: Hardware Requirement of Video Wall

No.	Item	Requirements
1.	Display Type	Colour DLP Laser or LED light source
2.	Display Size	70 inches or higher - DLP Cube- With Laser Light Source or LED Light Source – SLIM Cube
3	Videowall Grid	Videowall in the matrix with 48 (8 cubes in column and 6 cubes in row)
4.	Number of pixels	1920×1080 (full HD), 16:9 Widescreen
5.	Contrast Ratio	1800:1 or higher
6.	Brightness	700 nits
7.	Bezel-to-Bezel Width	0.44 or Bezel less
8.	Viewing angle	178 degree/178 degree (H/V)
9.	Access to the Cube	Front/Rear access
10.	Input Signal	RGB Digital, DVI-D or HDMI (Input interface shall be compatible with output interface of Video Switches.)
11.	Control input	RS-232C(D-SUB9) or RJ-45(10/100BASE-T)
12.	Expected Power Consumption	400VA or less
13.	Mount	VESA Standard Mount Interface
14.	Control	On Screen Display (OSD) - IP/IR remote control
15.	Operations	24 x 7, Life of light source 100000 hrs in eco-mode.
16.	Standards	BIS or equivalent

8.6 Video Switch

Table 8-6: Hardware Requirement of Video Switch

No.	Item	Specifications
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1.	Controller	Controller to control Video wall of 48 panels/cubes (considering future scalability) as per requirement along with software
2.	Chassis	19" Rack mount, Capacity up to 24 slots on MBD.

3.	Processor	Latest Generation 64 bit Quad Core processor (3.4 Ghz) or better
4.	Operating System	Pre-loaded 64-bit Operating System Windows / Linux / Equivalent, with recovery disc
5.	RAM	16 GB DDR3 ECC RAM
6.	HDD	2x500 GB 7200 RPM HDD (Configured in RAID 0)
7.	Networking	Dual-port Gigabit Ethernet Controller with RJ-45 ports
8.	RAID	RAID support 0, 1"
9.	Power Supply	(1+1) Redundant hot swappable
10.	Accessories	104 key Keyboard and Optical USB mouse
11.	USB Ports	Minimum 4 USB Ports
12.	Redundancy support	Power Supply, HDD, LAN port & Controller
13.	Scalability	Display multiple source windows in any size, anywhere on the wall
14.	Control functions	Brightness/Contrast/ Saturation/ Hue / Filtering/ Crop/ Rotate
15.	Inputs	LAN input from CCTV LAN. Controller should be able to decode minimum 120 4MP H.265 IP streams @ 4Mbps bitrate from TIDS (CCTV) system using hardware decoding and display them on the video wall in Full HD resolution. The controller should also have at least 4 DVI/HDMI (4x4=16) inputs and scalable up-to 24 DVI/HDMI for connecting workstations.
16.	Output	To connect scalable up-to 48 ports Displays through HDMI / DVI.
17.	Operating Temperature	10°C to 35°C, 80 % humidity
18.	Cable & Connections	The Contractor should provide all the necessary cables and connectors, so as to connect Controller with Display units
19.	Integration	Seamless integration among display unit, controller, wall management software to be ensured. Preferred to have same OEM.

8.7 LED Display

Table 8-7: Hardware requirement of LED display

No	Item	Requirements
1.	Product Type	LED-backlit LCD flat panel display with touchscreen
2.	Diagonal Size	70"
3.	Commercial Use	Yes - interactive
4.	Resolution	1920 x 1080
5.	Display Format	1080p (Full HD)
6.	Video Interface	HDMI
7.	HDMI Ports Qty	3 ports
8.	PC Interface	VGA (HD-15), DisplayPort, Mobile High-Definition Link (MHL)
9.	LCD Backlight Technology	LED backlight
10.	Image Aspect Ratio	16:9
11.	TV Tuner	No tuner
12.	Speaker System	2 speakers
13.	USB	Yes
14.	Included Accessories	Remote control, 2 styluses, stylus pen holder, wireless remote control, wire saddle, remote control holder, LSA1U wall mount kit
15.	Voltage	AC 120/230 V (50/60 Hz)
16.	Power Consumption Operational	220 Watt
17.	Power Consumption Stand by	0.4 Watt
18.	Dimensions (WxDxH)	159.35 cm x 9.51 cm x 93.261 cm
19.	Environmental Standards	ENERGY STAR Qualified

8.8 Overhead Projector

Table 8-8: Hardware requirement of Overhead Projector

No	Item	Requirements
1	Display Technology	Polysilicon TFT 3LCD
2	Resolution	WXGA, 1280x800, 16:10
3	Colours	1.07 billion Colours
4	Brightness	4000 or more ANSI lumens (in Normal Mode)
5	Contrast Ratio	2200:1 / 10000:1 (dynamic)
6	Video Input	One computer (D-Sub, Standard 15 pin VGA connector) One HDMI
7	Keystone Correction	Horizontal and vertical
8	Zoom and Focus	Manual Zoom and Focus
9	Audio	Internal speaker
10	Remote Operations	Full function Infrared Remote Control
11	Other features	Auto source detect, Auto-Synchronization, Keystone Correction

12	Mounting	Ceiling mount with fixed structure, with all accessories and cables
13	Lamp Life	Up to 3000 hour(s) / up to 5000 hour(s) (economic mode)

14	Lamp Type	260 Watt
15	Lens aperture	F/2.4-2.66
16	Power	AC 230 V (50 Hz) Projection Distance: 4 ft. - 33 ft.

8.9 IP Phone

Table 8-9: Hardware requirement of IP Phone

No	Item	Requirements
1	Headset	Port for Headset (Headset also to be provided)
2	VoIP Protocol	SIP V2
3	PoE	IEEE 802.3af or better
4	Supported Protocols	SNMP, DHCP, DNS
5	Codecs	G.711, G.722 including handset and speakerphone
6	Speaker Phone	Full duplex speakerphone with echo cancellation speaker on/ off button, microphone mute
7	Volume control	Easy decibel level adjustment for speakerphone, handset, and ringer
8	Phonebook/Address book	Minimum 100 contacts
9	Call Logs	Access to missed, received, and placed calls. (Minimum 20 overall)
10	Clock	Time and Date on display
11	Ringer	Selectable Ringer tone
12	Directory Access	LDAP standard directory

8.10 Call Recording Device

Table 8-10: Hardware Requirement of Call Recoding Device

No.	Item	Specifications
1.	Connection method	Handset modular terminal
2.	Recording	Automatic, Manual: Recording from the beginning of the call even after call start
3.	Recording method	Voice-activated
4.	File format	MP3
5.	Maximum recording time	32GB: 2000 hours more
6.	Media	SD, mini-SD, SDHC
7.	External interface	USB 2.0 mini-B

8.11 Network Colour Laser Printer

Table 8-11: Hardware Requirement of Network Colour Laser Printer

No.	Item	Specifications
1.	Printing speed	30 ppm or higher (black, normal quality mode) 30 ppm or higher (colour, normal quality mode)
2.	First page out	Not more than 16 second (black, colour)
3.	Print resolution	600 dpi or higher (black) 600 dpi or higher (colour)
4.	Paper trays	2 (standard)
5.	Media size	A3 / A4
6.	Duplex (both sides) printing	Automatic
7.	Interface	100M Base LAN interface

8.12 Data Storage

Table 8-12: Hardware Requirement of Data Storage

No	Item	Requirements
1.	Solution/ Type	IP Based/iSCSI/FC/NFS/CIFS
2.	Storage	Storage Capacity should be a minimum of 50 TB (usable, after configuring in offered RAID configuration) for online and Near-line data.
		RAID solution offered must protect against double-disc failure.
		Disks should be preferably minimum of 8 TB capacity
		To store all types of data (Data, Voice, Images, Video, etc)
		Storage system capable of scaling vertically and horizontally
3.	Hardware Platform	Rack-mounted form-factor
		Modular design to support controllers and disk drives expansion
4.	Controllers	At least 2 Controllers in active/active mode
		The controllers / Storage nodes should be upgradable seamlessly, without any disruptions/downtime to production workflow for performance, capacity enhancement, and software/firmware upgrades.
5.	RAID support	RAID 0, 1, 1+0, 5+0 and 6
6.	Cache	Minimum 128 GB of useable cache across all controllers. If the cache is provided in additional hardware for a unified storage solution, then the cache must be over and above 128 GB.
7.	Redundancy and High Availability	The Storage System should be able to protect the data against a single point of failure concerning hard disks, connectivity interfaces, fans, and power supplies
8.	Management software	All the necessary software (GUI Based) to configure and manage the storage space, RAID configuration, logical drives allocation, snapshots, etc. are to be provided for the entire system proposed.

		Licenses for the storage management software should include disc capacity/count of the complete solution and any additional disks to be
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No	Item	Requirements
		plugged in in the future, up to the max capacity of the existing controller/units.
		A single command console for the entire storage system.
		Should also include storage performance monitoring and management software
		Should provide the functionality of proactive monitoring of Disk drive and Storage system for all possible disk failures
		Should be able to take "snapshots" of the stored data to another logical drive for backup purposes
9.	Data Protection	The storage array must have a complete cache protection mechanism either by de-staging data to disk or providing complete cache data protection with battery backup for up to 4 hours

8.13 Backup Software

Table 8-13: Hardware requirement of Backup software

No	Item	Requirements
1	General	<ul style="list-style-type: none">■ The software shall be able to back up the necessary and relevant video feeds from storage, various databases, etc. The device should provide minimum throughput of 10Gbps■ Should support file-level backup/recovery■ Should perform Scheduled unattended backup using policy-based management for all Server and OS platforms■ The software should support online backup and restore of various applications and Databases■ Should support database platforms like Microsoft Exchange Server, Oracle, Microsoft SQL Server, Microsoft SharePoint, Sybase, MySQL, Informix, IBM Domino (Lotus), SAP, IBM DB2, Big database etc.■ Should support backup hardware like tape, virtual tape, optical, disk, interface hardware, etc■ The backup software should be capable of having multiple back-ups sessions simultaneously■ The backup software should support different types of backup such as Full back up, Incremental back up, Differential back up, Selective back up, Point in Time back up, and Progressive Incremental back up and snapshots■ The backup software should support different types of user interface such as GUI, Web-based interface■ Should have logging and reporting features

8.14 Tape Library

Table 8-14: Hardware requirement of Tape library

No.	Requirements
1.	<ul style="list-style-type: none">■ Shall support Native data capacity of 200TB■ (uncompressed) expandable to 400TB (compressed).
2	<ul style="list-style-type: none">■ Shall be offered with Minimum of four LTO7 FC tape drive. Drive shall support encryption.
3	<ul style="list-style-type: none">■ Shall be offered with minimum of 48 Cartridge slots and scalable to minimum 100 Cartridge
4	<ul style="list-style-type: none">■ Tape Library shall provide 8 Gbps native FC connectivity to SAN switches.
5	<ul style="list-style-type: none">■ Library shall be able to back up the encrypted keys in a redundant fashion
6	<ul style="list-style-type: none">■ Tape Library shall provide web based remote management.
7	<ul style="list-style-type: none">■ The library should have cartridge I/O slots for secure & easy off-site backup storage
8	<ul style="list-style-type: none">■ Tape Library shall have GUI Panel■ Shall be rack mountable.■ Shall have option for redundant power supply

9	■ Should support industry leading backup software
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No.	Requirements
10	■ 40 LTO7 barcode labelled cartridges & 4 cleaning cartridges from the tape library OEM to be provided

8.15 Network Switch -Level 2

Table 8-15: Hardware Requirement of Network Switch -Level 2

No.	Item	Requirements
1.	Switching bus	56 Gbps or more Switching fabric capacity or better
2.	WAN Interface	1) 10/100BASE-TX x4 port or more 2) Optical port (Media Converter) x2 port or more
3.	LAN Interface	100/1000BASE-T x16 port or more and two SFP
4.	LAN Protocol	TCP/IP, IP Multicast
5.	Level 2 switching function	Present
6.	Maximum VLAN	200 or better
7.	VLAN Trunk function	Support 802.1Q Tagged VLAN and port-based VLANs and Private VLAN The switch must support dynamic VLAN Registration or equivalent Dynamic Trunking protocol or equivalent Should support Media access control (MAC) authentication to provide simple authentication based on a user's MAC address
8.	Spanning Tree	Possible
9.	Routing Protocol	RIP, RIPv2, OSPF Network Time Protocol or equivalent Simple Network Time Protocol support. The switch should support traffic segmentation. Traffic classification should be based on user-definable application types: TOS, DSCP, Port-based, TCP/UDP port number
10.	Multicast	IGMP
11.	Monitoring/control	SNMPv1, v2, and v3 and Remote monitoring (RMON) support
12.	Power	AC230V
14.	Grade	Industrial

8.16 Network Switch -Level 3

Table 8-16: Hardware Requirement of Network Switch -Level 3

No.	Item	Requirements
1.	Switching bus	56 Gbps or more Switching fabric capacity or better
2.	WAN Interface	1) 10/100BASE-TX x4 port or more 2) Optical port (Media Converter) x2 port or more
3.	LAN Interface	100/1000BASE-T x16 port or more and two SFP
4.	LAN Protocol	TCP/IP, IP Multicast

5.	Layer 3 switching function	Present
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No.	Item	Requirements
6.	Maximum VLAN	200 or better
7.	VLAN Trunk function	Support 802.1Q Tagged VLAN and port based VLANs and Private VLAN The switch must support dynamic VLAN Registration or equivalent Dynamic Trunking protocol or equivalent
8.	Spanning Tree	Possible
9.	Routing Protocol	RIP, RIPv2, OSPF Network Time Protocol or equivalent Simple Network Time Protocol support. Switch should support traffic segmentation. Traffic classification should be based on user-definable application types: TOS, DSCP, Port based, TCP/UDP port number
10.	Multicast	IGMP
11.	Monitoring/control	SNMP
12.	Power	AC230V

8.17 SAN Switch

Table 8-17: Hardware requirement of SAN switch

No.	Item	Requirements
1.	Converge	Fiber switch should be quoted with a minimum of 48 FC ports of 16 Gbps speed with all supported licenses from day one.
2.	Protocols	Fibre channel or Ethernet
3.	Controllers	The switch should have auto-sensing, zoning, integrate Ethernet, and a serial port for communication
4.	Chassis	The switch should be rack-mountable 1U size and should be supplied with a mounting kit
5.	Redundancy	The switch should be equipped with a redundant hot-swap power supply and fan and allow hot-swap ability with resetting the switch or affecting the operations of the switch

8.18 Load Balancer

Table 8-18: Hardware requirement of Load balancer

No	Item	Requirements
1	General	<ul style="list-style-type: none">■ The device should support load balancing of both TCP and UDP based traffic using algorithms like round-robin, weighted round-robin, least connections, persistent connects, etc■ The device should provide minimum throughput of 10Gbps■ The device should provide 4x10G ports scalable to an additional 4x10G ports■ Should support Client availability (Heartbeat) monitoring■ Should support High Availability in Active-Active, Active-Passive mode.■ Should be Manageable using CLI(SSH), WebUI(SSL), SNMP (V1, V2, V3), etc.■ The management option should allow configuration, operation, firmware upgrade, traffic reporting, error logs, status logs■ Should support IPv6 from day one■ Should support static and dynamic routing■ Should support Global Server Load balancing, URL based Load balancing, HTTP, HTTP redirection, HTTP Layer 7 redirection, DNS redirection, DNS Fallback redirection,■ Should be able to create and load HTTP/SSL certificates■ Should be Rack-mountable & should be supplied with Indian standard AC power cord■ Should support multiple instances having dedicated CPU, memory, SSL & I/O for guaranteed performance

8.19 Firewall

Table 8-19: Hardware Requirement of Firewall

No	Item	Requirements
1	Physical attributes	<ul style="list-style-type: none">■ Should be mountable on 19" Rack■ Modular Chassis■ Internal redundant power supply
2	Interfaces	<ul style="list-style-type: none">■ Minimum 8 x 10 GBPS Interface■ Console Port 1 number
3	Performance and Availability	<ul style="list-style-type: none">■ Encrypted Next Generation Firewall Throughput: minimum 20 Gbps for internet and 20 Gbps for intranet firewall"■ Concurrent connections: up to 100,000■ Simultaneous VPN tunnels: 2000
4	Routing Protocols	<ul style="list-style-type: none">■ Static Routes■ RIPv1, RIPv2■ OSPF

5	Protocols	<ul style="list-style-type: none">■ TCP/IP, PPTP■ RTP, LEVEL 2TP■ IPSec, GRE, DES/3DES/AES■ PPPoE, EAP-TLS, RTP■ FTP, HTTP, HTTPS
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No	Item	Requirements
		<ul style="list-style-type: none"> ■ SNMP, SMTP ■ DHCP, DNS ■ Support for Ipv6
6	Other support	<ul style="list-style-type: none"> ■ 802.1Q, NAT, PAT, IP Multicast support, Remote Access VPN, Time based Access control lists, URL Filtering, support VLAN, Radius/ TACACS
7	QoS	<ul style="list-style-type: none"> ■ QoS features like traffic prioritization, differentiated services, committed access rate. Should support for QoS features for defining the QoS policies.
8	Management	<ul style="list-style-type: none"> ■ Console, Telnet, SSHv2, Browser based configuration ■ SNMPv1, SNMPv2 ■ Should Support SDK for IOT

8.20 Network Rack/ Server Rack

Table 8-20: Hardware Requirement of Network Rack/Server Rack

No.	Item	Requirements
1.	Structure	In house independent type (Floor Mounted 19" 42U Rack)
2.	Material	<ul style="list-style-type: none"> ■ Steel plate or Aluminium extruded profile ■ 42U with Heavy Duty Extruded Aluminium Frame for rigidity. Top cover with FHU provision. Top & Bottom cover with cable entry gland plates. Heavy Duty Top and Bottom frame of MS. Two pairs of 19" mounting angles with 'U' marking. Depth support channels - 3 pairs with an overall weight carrying Capacity of 500Kgs. ■ Detachable side panels (set of 2 per Rack) ■ All racks should have mounting hardware 2 Packs, Blanking Panel. ■ Stationery Shelf (2 sets per Rack). ■ All racks must be lockable on all sides with unique key for each rack. ■ Racks should have Rear Cable Management channels, Roof and base cable access. ■ The racks must have steel (solid / grill / mesh) front / rear doors and side panels. Racks should NOT have glass doors / panels. Front and Back doors should be perforated with at least 63% or higher perforations. Both the front and rear doors should be designed with quick release hinges allowing for quick and easy detachment without the use of tools.
4.	Plate thickness	t=1.5mm more
5.	Cable manager	Four nos. of Horizontal covered PVC Cable manager and two nos. of Verticals covered PVD cable manager.
6.	Power Distribution Units	Two nos. of Vertically Mounted PDU 12 Point (5/15 amp) and 12 power outs IEC C13 sockets, 32 AMPS MCB, Surge and Spike Protection, LED Readout,
7.	Earthing Kit	Should have Rack Ground Kit of 5 KV AC isolated input to Ground & Output to Ground
8.	Ventilation	The rack shall have proper exhaust / ventilation using at least 4 fans housing units on top of the rack

8.21 UPS Parallel Redundant

Table 8-21: Hardware Requirement of UPS

No.	Item	Requirements
1.	Input voltage	■ Commercial Power generally but with existing condition of power failure, instantaneous power failure and voltage fluctuation
2	UPS	■ Adequate capacity to cover the System Components at respective location ■ Three 3 hours or longer backup power supply for Equipment in TIMS-CCC. ■ Ability to shutdown equipment safely when low battery. ■ Ability to start up equipment safely when restoration of AC power. ■ Protection for voltage fluctuation and voltage spike. ■ Output: AC 230 V / 50 Hz sine wave, constant voltage and constant frequency. ■ Long life battery to meet the Design Life. ■ Output condition shall meet equipment to be supplied by the Contractor. ■ Applying appropriate measures in order to be available even in severe environmental conditions outdoors.

8.22 Wi-Fi Equipment

Table 8-22: Hardware requirement of Wi-Fi equipmen

No.	Item	Requirements
1.	Wi-Fi	Contractor shall implement industrial grade and rugged Wi-Fi router device in CCC to support and operational minimum define option: ■ 802.11 – Pertains to wireless LANs and provides 1 - or 2-Mbps transmission in the 2.4-GHz band ■ 802.11a – an extension to 802.11 that pertains to wireless LANs and goes as fast as 54 Mbps in the 5-GHz band. ■ 802.11g – Pertains to wireless LANs and provides 20+ Mbps in the 2.4-GHz band. ■ 802.11b – 802.11 high rate WIFI is an extension to 802.11 that pertains to wireless LANs and yields a connection as fast as 11 Mbps transmission in the 2.4-GHz band

9 Communication Requirement

Table 9-1: Communication Requirements of TIMS-CCC

No.	Requirements
1.	■ Communication requirements between the roadside equipment and the system server of each subsystem are specified in the requirement of each subsystem.
2.	■ Communication for the replication from physical server environment to the cloud environment shall be a fibre network (Broadband Service) provided by a single communication company.
3.	■ C2C (Centre to Centre) Communication between TIMS-CCC and CBS-CCC shall be a fibre network (MPLS VPN) by a single communication company.

10 Installation Requirement

The followings shall be considered while Installing equipment's at the control center. The Contractor shall obtain approval for installation location/place before installing Console equipment's and other necessary infrastructure arrangements such as furniture's, false ceiling, Power, Communication etc. as enumerated in functional requirement. .

- Conduct installation of the equipment with prudent consideration to earthquake-resistance.
 - Proper space should be secured behind Video Wall for heat releasing and maintenance work.
 - All cables should be installed with proper cable wiring arrangement structure in order not to disturb the flow line of users.
-

Chapter 2-2 Requirements of Integrated Traffic Management System

1 General

The proposed Integrated Traffic Management System (ITMS) shall provide capacity building support to city authorities as per the scope of services described below. Any functionality not expressly stated in this document but required to meet the needs of the Chennai-ITS and to ensure successful operations of the system shall essentially be under the scope of the Contractor without any extra cost to Employer during the Project Period.

Following key tasks shall be covered under this initiative:

- (a) TIDS cameras including Fixed and PTZ cameras for live video monitoring Integrated with ITMS system.
- (b) Monitor the ongoing activities at the key traffic junctions.
- (c) ATCS system monitoring, controlling and analytics required for city traffic as per desire shall take place from single location.
- (d) Facilitate traffic rules enforcement through design, supply, and installation of Red-Light Violation Detection (RLVD) and speed Limit violation detection (SLVD). Each of these systems shall be integrated with ITMS system.
- (e) Integrate e – challan system with traffic enforcement cameras, sensors, for automated issuance of challans and further audit as and when required by the Employer.
- (f) System shall collect probe data from CBS system, and ATCC for calculation and alert generation for city traffic congestion, density and estimated traveling time. In future, the proposed ITMS system shall be capable to integrate required Probe taxi data or any other probe data.
- (g) System shall show all the equipments live location, health status, incidents, SLA monitoring in integrated way on single screen.
- (h) Create a Centralized Management Information System (MIS) as a part of the ITS solution for faster decision making in traffic emergency such as heavy rain fall, accidents, terrorist attack, VVIP movements or any other situation as required by the Employer etc.
- (i) Cooperate, manage and train the administrative staff and offer back-end support on the operations of the ITMS using the departmental manpower
- (j) To disseminating scalable and analyzed traffic information on connected VMS as well as virtual VMS locations.
- (k) To collected traffic information, flood information, incidents from other projects /Government. agency to analysis and generate alert for ITS system
- (l) Disseminating Traffic information for road user on request and emergency through VMS, SMS, Website, mobile app.
- (m) Disseminating information for external agency, stock holder and government. department.

Contractor shall implement and deliver the following systems and capabilities linked with ITMS system and shall be controlled and monitored from single location –

- (a) Probe data collection and traffic information dissemination.
 - (b) Automatic Traffic Counters-cum-classifier (ATCC) System
 - (c) Adaptive Traffic Signal Control System (ATCS)
 - (d) Red Light Violation Detection (RLVD) System
 - (e) Speed Limit Violation Detection (SLVD) System
 - (f) Traffic Incident Detection System (TIDS)
 - (g) Variable Message Sign (VMS)
-

Overall system configuration and TIMS system configuration are shown below.

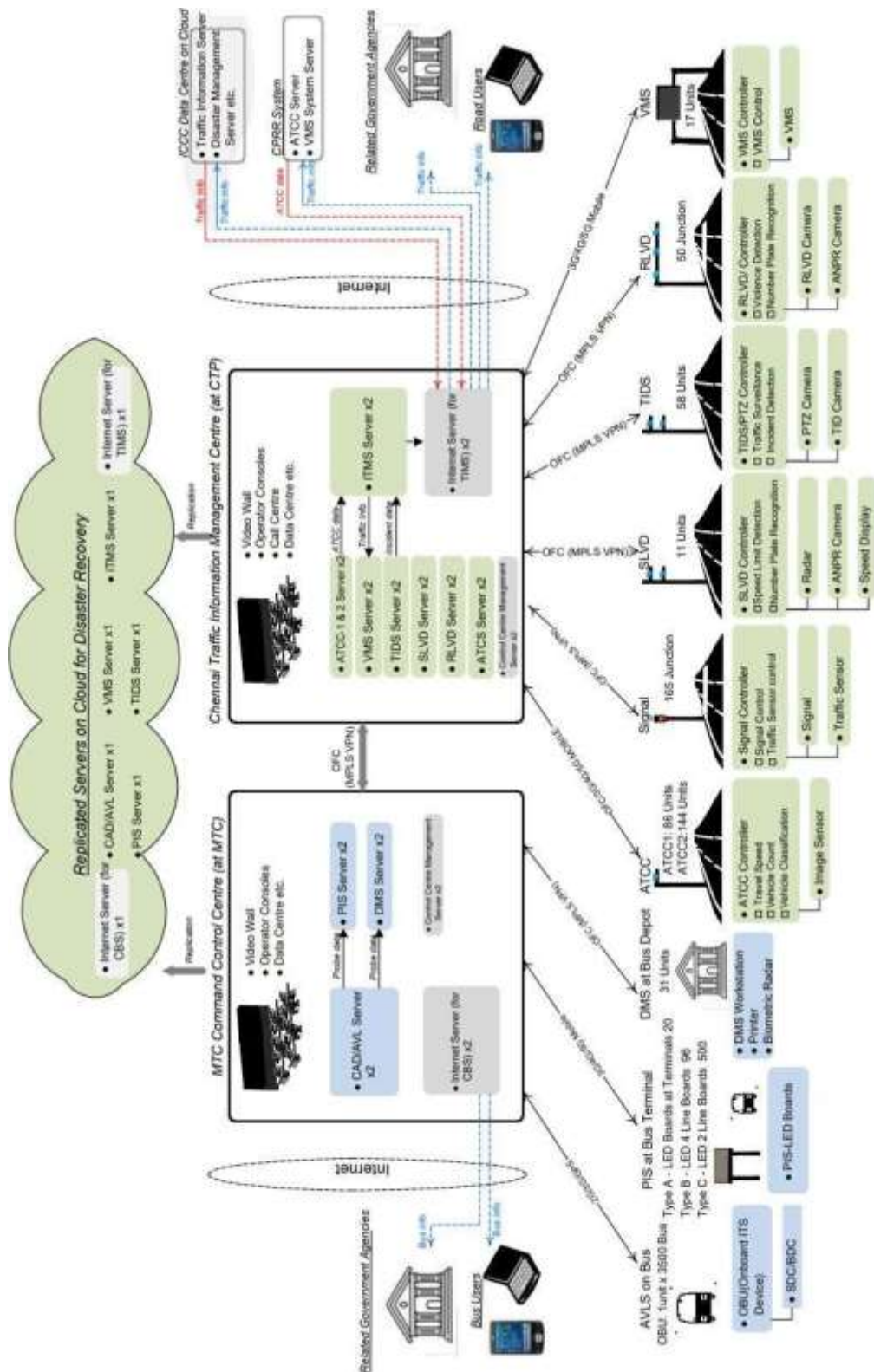


Figure 2-1: Overall System Configuration of CITS

Project

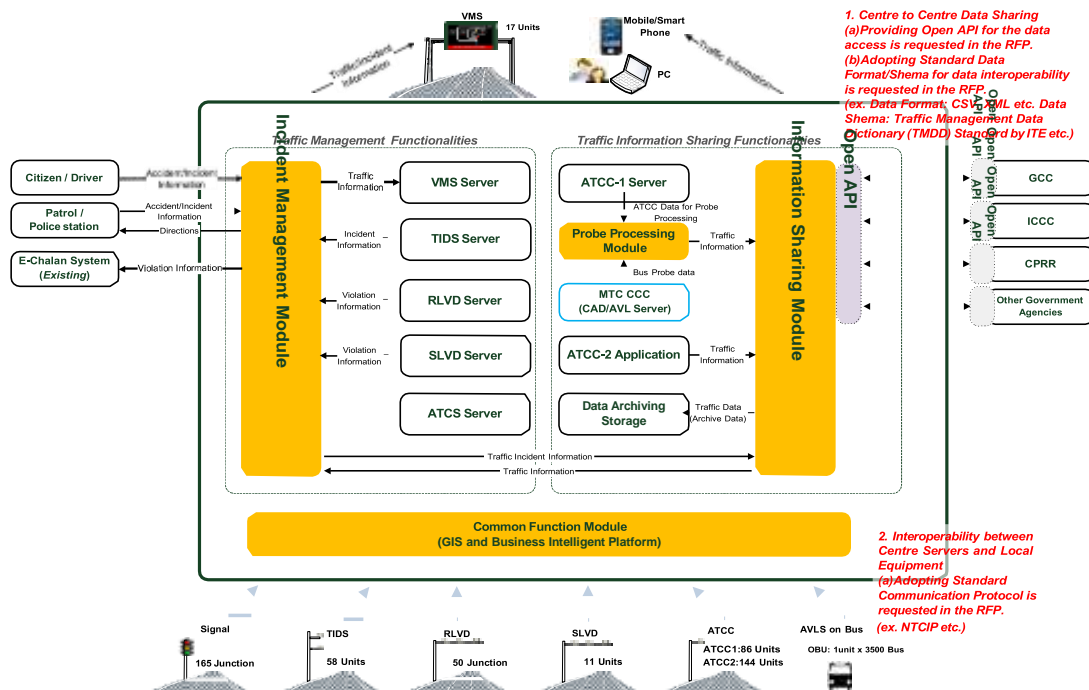


Figure 2-2: System Configuration of TIMS

3 System Functional Requirements

The ITMS platform shall have several functional modules such as Incident Management Module, Information Sharing Module, Probe Processing Module, Enterprise Management and Module CommonFunction Module as the minimum requirement. The ITMS platform shall be capable of adding additional modules based on the future requirements.

The web site and Mobile application shall be provided as the part of the system. The language option for web site and Mobile application shall be English and Tamil and upgrade options shall be provided.

4 Equipment Location

Integrated Traffic Management System will be established at TIMS command and control centre at theOffice of Commissioner of Police.

Table 4-1: TIMS CCC Location

No.	Location Type	Location Name
1	TIMS Command Control Center	Office of Commissioner of Police, Vepery

4.1 Functional Requirements of ITMS Command Control Software

Table 4-2: Functional requirement of ITMS Command Control Software

No.	Requirements
General Function	
1.	<ul style="list-style-type: none">■ The proposed software should have functions of GIS and Image Processing along with advance functions such as network analysis, terrain analysis, 3D analysis, change analysis, etc.■ The proposed GIS software could be any Industry standard COTS GIS platform and should be easy to handle, operate, maintain & also train the staff/end users.■ Software (Application, Database and any other) must not be restricted by the license terms of the OEM from scaling out on unlimited number of cores and servers during future expansion.■ The solution should be network and protocol agonistic and provide option to connect legacy system through API's with either read, write or both options. It should connect diverse on premise and/or cloud platform's and makes it easy to exchange data and services between them.■ GUI shall be highly user friendly, self-explanatory and eye catching. It shall provide the sample example wherever it seeks user input and also preserve the history of the inputs. GUI can be made good looking and beautiful by making use of good color scheme and putting functions indicative image (drawing) on button.■ The customized software for the organization/department should have simple user interface both for departmental users as well as for citizens with easy navigation and querying facility.■ The software should support OGC Services such as WMS, WFS, WCS, CSW, INSPIRE, etc along with GML, KML, etc.■ The software should support all types of raster formats and services like ERDAS IMAGINE, ENVI, PIX, DTED, DEM, CEOS, JPEG, JP2, PNG, GeoTIFF, & Web Coverage Service (WCS, OGC standard), Web Map Service (WMS), OGC standard.■ ODBC compliance enabling interface with RDBMS like Post GRE SQL, Oracle, SQL server, Access etc. should be available.■ No proprietary protocol shall be used among the system and device. If any then same information shall be submitted to Employer including Code and related documentation.
Convergence of Multiple feeds/ Services	
1.	<ul style="list-style-type: none">■ System needs to have provision that integrates various services and be able to monitor and operate them. The solution should provide scalability option to implement new use cases.■ System should have capability to source data from other systems implemented within the city to create actionable intelligence.■ Contractor shall design & support populating project (static & real-time) data in open data format and support requirements of developer portal which will be part of the Chennai's Open Data initiative, which is currently under development.■ Contractor shall support defining and integrating project data with Namma Chennai App to support requirements of the Namma Chennai App users.
2.	<p>Industry Standards for the Command & Control Center</p> <ul style="list-style-type: none">■ The solution should adhere to the Industry standards for interoperability, data representation & exchange, aggregation, virtualization, and flexibility■ IT Infrastructure Library (ITIL) standards for Standard Operations Plan & Resource Management.■ Business Process Model and Notation (BPMN) or equivalent for KPI Monitoring.■ Platform must have an intuitive data flow-based drag and drop studio, where the data can

	<p>be pulled from different connectors and the transformed using pre-build functions or using custom functions</p> <ul style="list-style-type: none"> ■ Platform must provide a rich set of built-in functions to transform the data from one format to another.
GIS Functions	
1.	<ul style="list-style-type: none"> ■ The proposed software should support multiple document interface (MDI), User should be able to create multiple views in single project. ■ The application framework of the software should be such that it should have Dockable /Floating Toolbars, Dockable and Auto Hiding Windows, Unicode Support for Multilanguage Attributes, Drag and Drop to Rearrange Tools/Toolbars, Create New Toolbars or Menus without Programming, Extend the Applications with Add-ins built with .NET, Java, or Python, Build New GIS Components with .NET or Java or other development platforms. ■ The proposed software should have capability to create layer as per the data model defined by the authority. User should be able create table structure as per the requirement ■ The software should have provision for definition of map projection system and geodetic datum to set all the maps in a common projection and scale. ■ It should have facility to create custom projection using 3 to 7 parameters. ■ It should have the facility to display multiple projection coordinates on map click. ■ The software should provide facility to click on any feature of the map and return a select set of attributes for feature i.e. Identify tool along with pop-up. ■ Software should have rich geo-processing functions such buffer generation, clip, erase, intersection, dissolve, union, polyline to polygon, etc. It should have facility to perform the spatial intersection analysis like plot area with buffer zone to calculate road-widening impact on adjacent land. ■ The Software should be able to import / export data from / to various formats like .dwg,, dxf, .dgn, .shp (shape files), coverage file, .mif (MapInfo), .mdb (GeoMedia), .gml, .kml, .gpx, , Geo PDF GeoJSON, interlis, GeoRSS, SqlLite etc ■ The proposed software should have function to import / export tabular data suchas .xlsx, .csv, .dbf, etc ■ Support of Coordinate Geometry (COGO) description for GIS objects creation and store in GIS database. ■ Facility to define joins between the two tables (graphic / non-graphic) of the database to get integrated information in the table and perform GIS analysis. ■ The system should provide the facility to exchange the GIS Data with other platform applications like Word, and Excel to use GIS data and generate reports like graph and charts ■ The software should have rich display and navigation tools. It should have zoom in, zoom out, fixed zoom in, fixed zoom out, pan, real-time pan, bookmark, Geo link multiple views, swipe, flicker, search by location, crosshair, cursor location value, numeric dump, query cursor, etc. It should have the support of continuous panning i.e., real-time pan. ■ The software should have a module for geo-referencing of vector and raster data. ■ Facility to capture the geometry from the layout maps, building maps by maintaining the coincident geometry i.e. when a new polygon is captured simply by selecting an existing polygon to digitize the common boundary thereby ensuring no slivers or gaps between adjacent area features like parcels. ■ The software should provide a complete set of drawing & editing tools to enable the user to Draw & Modify any or parts of various geographical objects (point, line, and polygon) on the map. ■ The software should have a topology creation tool to remove the topological errors from vector data. ■ The software should have a provision of hyperlinking the GIS feature as well as its

	<p>attribute fields with existing documents, URLs, Images, drawing files, or scanned maps related to that feature</p> <ul style="list-style-type: none"> ■ The software should have versioning capability for history tracking. ■ The customized application should provide the user facility to make dynamic queries on GIS GUI. The application should allow users to store and retrieve standard queries used by them in day-to-day operations. ■ The software should allow users to export results to various file formats like EMF, BMP, TIFF, JPEG, PDF, etc. ■ The software should have a map composition/layout tool for printing spatial data at different scales and adjustable print quality.
Integrated User Specific & Customizable Dashboard	
1.	<ul style="list-style-type: none"> ■ Should provide an integrated dashboard with an easy to navigate user interface for managing profiles, groups, message templates, communications, tracking receipts, and compliance ■ Collects major information from other integrated ITS components/platforms. Should allow different inputs beyond cameras, such as PC screen, web page, and other external devices for rich screen layout Multi-displays configurations ■ Use of GIS tool which allows easy map editing for wide-area monitoring (Google map, Bing map, ESRI Arc GIS map, etc.). ■ Should provide historical reports, event data & activity log. The reports can be exported to pdf or HTML formats. ■ Should provide tools to assemble personalized dashboard views of information pertinent to incidents, emergencies & operations of the command center ■ GIS Dashboard must have minimum following layers <ul style="list-style-type: none"> √ ATCC Type 1 Layer √ ATCC Type 2 Layer √ ATCS Layer √ RLVD Layer √ SLVD Layer √ VMS Layer √ TIDS Layer √ AVL/CAD Layer √ PIS Layer √ DMS Layer ■ GIS details procured shall include the following data with attributes <ul style="list-style-type: none"> √ Road Network <ul style="list-style-type: none"> • City Arterial Road • Street • National Highways • State Highways etc. √ Administrative Boundaries <ul style="list-style-type: none"> • District and Sub District Boundary • Town Boundary √ Building footprint and names √ Point of interest data to include <ul style="list-style-type: none"> • Health service (Hospital, Blood Bank, Medical service, etc.) • Community Services (Fire Station, Police station, Bank, ATM, Education Institute, Govt. Buildings, etc.)

	<ul style="list-style-type: none"> • Business center (Shopping Mall, Market, Commercial complex, etc.) • Transportation (Bus Stop/Terminal, Parking Area, Railway station, Petrol pump, Metro station, Seaport, Airport, etc.) • Residential Area (Apartment, Housing society, etc.) • Road Amenity (Flyover, Foot Over, Underpass, etc.) <ul style="list-style-type: none"> ■ Should provide dashboard filtering capabilities that enable end-users to dynamically filter the data in their dashboard based upon criteria, such as region, dates, product, brands, etc. and capability to drill down to the details
2	<ul style="list-style-type: none"> ■ The software should have the capability to process optical satellite data as well as microwave image data etc. ■ The software should support image format such .tif, geotiff, .img, .pix, .hdr, .h4, .h5, DTED, DEM, CEOS, .bmp, .jpeg, etc. ■ The software should have a module for image mosaicing and splitting. ■ It should have Layer stacking to create a composite image from several bands of the satellite imageries. ■ The software should have an image enhancement module to enhance the imageries. It should have an enhancement algorithm such as Linear, Logarithmic, Histogram Equalize, Histogram Matching, Density Slice, Gaussian, Squire root, Tone Balancing ■ The software should have a Natural Color image generation module using NIR, Red, and Green bands of high-resolution multispectral image data. This module should have the capability to stretch the natural color image. ■ The change detection module should have the capability of Object Library Creation for Object Identification and Automatic Feature Extraction (AFE). ■ The software should have a function called Dynamic threshold for analyzing change detection using the image. This function is used to categorize the pixels in the input image based on the threshold value. ■ The application should be highly interoperable with the ability to import and export to a wide range of industry-standard formats including CAD (DGN, DXF, DWG), ArcGIS geodatabases, Geo Media Warehouse, MapInfo, GML (GEOGRAPHY MARKUP LANGUAGE), XML, SHP, ArcInfo Coverage, ESRI Arc Info Export (EOO), Micro Station V7/V8, Geo PDF GeoJSON, interlace, GeoRSS, SqlLite, etc. ■ Should be capable of maintaining data history, version management, and conflict detection/resolution. ■ Should have the capability of centrally managed data, models, tools, maps, and applications. ■ Should have a geo-processing framework, geoprocessing core analysis functionalities, spatial and statistics analysis functionalities. ■ Application Server must support Time aware data for Trends / Time Series Analysis. ■ Application Server must support network and perform Routing analysis, Service Area Analysis, etc. ■ Should support database check-in-check out/replication functionalities hence maintaining the parent-child relationship of Master Database. ■ Platform must have the ability to connect to different source systems using varied connection protocols and consume the data that can be either used for ingestion into the platform database or be directly pushed for the visualization layer to be consumed by visualization layer or be exposed as an API to be consumed by 3rd party ■ Platform must have the ability to create connection templates that holds the security configuration of a source system and this template can be used by different connectors to connect to the source system and receive or consume the data ■ Platform must have the ability to perform both persistent and non-persistent connections
Command & Control Center Components	

1.	<ul style="list-style-type: none"> ■ Web server to manage client requests. The client should provide web-based, one-stop portals to event information, overall status, and details. The user interface (UI) to present customized information in various pre-configured views in common formats. All information to be displayed through easy-to-use dashboards. ■ Application server to provide a set of services for accessing and visualizing data. Should be able to import data from disparate external sources, such as databases and files. It should provide contacts and instant messaging services to enable effective, real-time communication. It should provide a business monitoring service to monitor incoming data records to generate key performance indicators. It should also provide users to view key performance indicators, standard operating procedures, notifications, and reports, spatial-temporal data on a geospatial map, or view specific details that represent a city road, building, or an area either on a location map or in a list view. The application server should provide security services that ensure only authorized users and groups can access data. ■ Analytics functionality can be part of an application server or separate server
Integration with Social Media & Open	
1.	<ul style="list-style-type: none"> ■ Should provide integration of the Incident Management application with the social media. Should Provide analytics based on the social media feed, other big data sources as identified by CSCL/GCC/CTP/MTC
Incident Management Flow Function	
1.	<ul style="list-style-type: none"> ■ The application shall be able to provide the management flow, activity, party to be communicated such as hospital, etc, and report/approved to/by, contact information to the operator. ■ The application shall make it possible for the operator to confirm the status of the management flow. ■ All activity shall be logged ■ The application shall make it possible for operators to create/adjust and pre-set process flows. ■ Follow can be added and modified by easy operation by the operator ■ The application shall be able to keep active status from the utterance to resolve the incident. ■ Should support for sudden critical events and linkage to standard operating procedures automatically without human intervention. ■ Should support for multiple incidents with both segregated and/or overlapping management and response teams. ■ Should support Geospatial rendering of event and incident information. ■ Should support plotting of area of impact using polynomial lines to divide the area into multiple zones on the GIS maps. ■ Should support comprehensive reporting on event status in real-time manually or automatically by ITS Equipment ■ The system must provide Incident Management Services to facilitate the management of response and recovery operations. ■ Should provide the facility to capture critical information such as location, name, status, time of the incident and be modifiable in real-time by multiple authors with role-associated permissions (read, write). Incidents should be captured in standard formats to facilitate incident correlation and reporting. ■ The system must identify and track the status of critical infrastructure/resources and provide a status overview of facilities and systems ■ Should provide detailed reports and summary views to multiple users based on their roles. ■ Provide User-defined forms as well as Standard Incident Command Forms for incident management.

	<ul style="list-style-type: none"> ■ A Reference Section in the tool must be provided for posting, updating, and disseminating plans, procedures, checklists, and other related information.
Source Intelligence	
1.	<ul style="list-style-type: none"> ■ Source intelligence and collate with the surveillance inputs to alert the responders for immediate action on the ground. ■ Should extract messages and display them in an operational dashboard. ■ Should be able to correlate the extracted message from the ITS equipment and social media with existing other events and then should be able to initiate an SOP. ■ Should be able to identify the critical information and should be able to link it to an existing SOP or a new SOP should be started. ■ Should provide notifications to multiple agencies and departments (on mobile) that new intelligence has been gathered through the open source/social media.
Equipment Status	
1.	<ul style="list-style-type: none"> ■ Should provide an icon-based user interface on the GIS map to report nonfunctional devices. ■ Should also provide a single tabular view to list all devices along with their availability status in real-time. ■ Should provide User Interface to publish messages to multiple devices at the same time.
Event Correlation	
1.	<ul style="list-style-type: none"> ■ Command & Control Center should be able to correlate two or more events coming from different subsystems (incoming sensors) based on time, place, custom attribute and provide correlation notifications to the operators based on predefined business and operational rules in the configurable and customizable rule engine.
Standard Operations Procedures	
1.	<ul style="list-style-type: none"> ■ Command & Control Center should provide for authoring and invoking an unlimited number of configurable and customizable standard operating procedures through a graphical, easy-to-use tooling interface. ■ Standard Operating Procedures should be established, approved sets of actions are the best practices for responding to a situation or carrying out an operation. ■ The users should be able to also add comments to or stop the SOP (before completion). ■ The users should be able to edit the SOP, including adding, editing, or deleting the activities. ■ There should be provision for automatically logging the actions, changes, and commentary for the SOP and its activities, so that an electronic record is available for after-action review. ■ Platform must provide the ability to use the outbound adapters as outbound tasks that can be to trigger actions or send data or invoke the 3rd party devices or 3rd party application ■ Platform must provide the ability to assign SOP templates to an event that is raised ■ Platform must provide the ability to approve or reject an SOP from getting executed for an event that is raised ■ Platform must provide an ability to trigger multiple tasks at the same time ■ Platform must provide ability to trigger external APIs as part of SOP steps. ■ The SOP Tool should have the capability to define the following activity types: <ul style="list-style-type: none"> ✓ Manual Activity - An activity that is done manually by the owner and provides details in the description field.

	<ul style="list-style-type: none"> ✓ Automation Activity - An activity that initiates and tracks a particular work order and selects a predefined work order from the list. ✓ If-Then-Else Activity - A conditional activity that allows branching based on specific criteria. Either enter or select values for Then and Else. ✓ Notification Activity - An activity that displays a notification window that contains an email template for the activity owner to complete, and then sends an email notification. ✓ SOP Activity - An activity that launches another standard operating procedure.
Key Performance Indicator	
1.	<ul style="list-style-type: none"> ■ Command & Control Center should be able to facilitate measurement or criteria to assay the condition or performance of departmental processes & policies. ■ Green indicates that the status is acceptable, based on the parameters for that KPI, no action is required. ■ Yellow indicates that caution or monitoring is required, action may be required. ■ Red indicates that the status is critical, and action is recommended.
Reporting Requirements	
1.	<ul style="list-style-type: none"> ■ Command & Control Center should provide easy to use user interfaces for operators such as Click to Action, Charting, Hover and Pop UPS, KPIs, Event Filtering, Drill down capability, Event Capture, and User-Specific Setup ■ The solution should generate Customized reports based on the area, ITS equipment type or periodic or any other customer reports as per the choice of the administrators ■ Reports shall support vernacular language.
BI Analytics	
1	<ul style="list-style-type: none"> ■ BI Analytics capability must be in-built in the platform without usage of additional COTS product or additional integrations ■ Platform must be capable of providing slice and dicing capability using the visual representations and actions available in the dashboard widget system ■ Platform must be capable of analyzing the data coming from different domains and the different sub-systems ■ Platform must have user friendly BI tool for manual as well as automated analytics. ■ Platform must be capable of mashing the data from different domains and different sub-systems, and thus provide cross-domain analysis capability ■ The Analytics engine must be an artificial intelligence-based module to maximize business value through advanced machine learning capabilities. The machine learning capabilities must aid in operations management and result in better outcomes. ■ Analytics Engine must have automatic Model training and retraining capability and should not have any manual intervention ■ Analytics Engine must be able analyze the simulated data, train the models using simulated data and predict the possible outcomes ■ Based on data analyzed from multiple data sources of the city, Analytics Engine must provide recommendations which can derive value/outcomes in terms of revenue optimization and cost savings for the city.
Authentication	
1.	<ul style="list-style-type: none"> ■ Should have the ability to respond to real-time data with intelligent & automated decisions ■ Support LDAP authentication mechanism ■ Provide policies using separate dimensions of authorization criteria like Traditional static Access Control Lists that describe the principals (users and groups) access to resources and the permissions each of these principals possesses. ■ Various users should be able to access the system using single sign-on and should be role

	<p>based. Different roles which could be defined (to be finalized at the stage of implementation) could be Administrator, Supervisor, Officer, Operator, etc.</p> <ul style="list-style-type: none"> ■ Apart from role-based access, the system should also be able to define access based on location. ■ Rights to different modules / Sub-Modules / Functionalities should be role based and proper log report should be maintained by the system for such access.
Situational Awareness COP (Common Operational Picture)	
1.	<ul style="list-style-type: none"> ■ The Command & Control Center Application should be able to combine data from various sources and present it as different views tailored to different operator's needs. ■ The Command & Control Center Application should automatically update the information based on alarms and incidents that are presented to it via the business rules engine. The polling and Command & Control Center Application database refresh cycle shall be configurable to match the status of the situation (whether there is an emergency or crisis or just monitoring only). ■ Common Operational Picture should comprise of a comprehensive view of the incident or a group of related incidents as on a specific date and time which should include but not be limited to the following: <ul style="list-style-type: none"> √ Task's assignment and their status √ Agencies involved √ Resources deployed √ Incident status across relevant parameters of the incident e.g., congestion due to accident and traveling time affect or any other unusual situation as required by the Employer √ A timeline view of the situation <p>Suggested actions from the system with their status</p>
Alarm Display	
1.	<ul style="list-style-type: none"> ■ Should have an ability to display alarm condition through visual display and an audible tone ■ Should have an ability to simultaneously handle multiple alarms from multiple workstations ■ Should have an ability to automatically prioritize and display multiple alarms and status conditions according to pre-defined parameters such as alarm type, location, Equipment, severity, etc. ■ Should display the highest priority alarm and associated data/video in the queue as default, regardless of the arrival sequence ■ Disseminating information on VMS
Historical Alarm Handling	
1.	<ul style="list-style-type: none"> ■ Should have an ability to view historical alarm details even after the alarm has been acknowledged or closed. ■ Should have an ability to sort alarms according to date/time, severity, type, and Equipment ID or location.
Security	
	<ul style="list-style-type: none"> ■ The architecture must adopt an end-to-end security model that protects data and the Infrastructure from malicious attacks, theft etc. Provisions for security of field equipment as well as protection of the software system from hackers and other threats ■ shall be a part of the proposed system. The evidence of Infraction should be encrypted and protected so that any tampering can be detected. ■ Ease of configuration, ongoing health monitoring, and failure detection are vital to the goals of scalability, availability, and security and must be able to match the growth of the environment.

	<ul style="list-style-type: none"> ■ The system should have secure access mechanism for validation of authorized personnel. ■ Roles and Rights of users should be defined in the system as per the requirements of the Employer. ■ Deletion or addition and transfer of data should only be permitted to authorized users. ■ A log of all user activities should be maintained in the system.
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4.2 Functional Requirements of Incident Management Module

The functional requirements of the incident management module are shown in the table below.

Table 4-3: Functional Requirements of Incident Management Module

No.	Requirements
Road and Traffic Monitoring Function	
1.	<ul style="list-style-type: none"> ■ The application shall be able to display the monitoring display of all TIMS subsystems. ■ The application shall be able to automatically display the real-time traffic information (congestion level information by color-coded) in the map-based view (schematic map view and GIS map view) on the video wall screen ■ The application shall be able to notify the occurrence of the incident by showing the alert or message on the display. the incident information such as type of incident, location, etc. graphically in the map-based view on the video wall screen.
Incident Registration Function	
1.	(1) Automatic Incident Registration <ul style="list-style-type: none"> ■ The application shall be able to automatically receive the traffic incident information detected by TIDS and heavily congested information by Probe System. ■ When the incident information is received, the application shall be able to notify the occurrence of incidents to operators displaying them on the map or making an alert. ■ When the incident information is received, the application shall be able to automatically create the pre-register data sets including incident type, location, time and serious level, etc., and show them to operators. The application shall be able to enable operators to modify the pre-register data sets as necessary before completing the registration. ■ The Contractor shall consider the integration of the incident data from the ICCC system and CPRR system in the above-mentioned automatic data registration function.
2.	(2) Manual Incident Registration <ul style="list-style-type: none"> ■ The application shall be able to manually register incident information collected through helpdesk, the notification from relevant agencies and news/websites as follows. √ Lane closure, accident, fallen object, construction work, stalled vehicle, pavement problem, adverse weather, fire nearby, etc. ■ The application shall be able to provide a useful user interface for manual data registration such as pull-down menus etc. to help operators. ■ The application shall enable operators to manually register various data such as traffic, weather, construction, etc. from the ICCC system and CPRR system.
VMS message creation	
1.	<ul style="list-style-type: none"> ■ If an incident is detected through another system, the system shall send an alarm to the VMS system. VMS system shall then create a warning message indicating the location, type of incident and action to be taken. ■ The application shall be able to create a VMS message but can be confirmed by the operator or authorized person to show by VMS. ■ The word which is frequently used such as “accident”, “congestion”, “construction work”, “slow down” and so on are used to compose a message combination by selection. They

	<p>contain words indicating location, event, and instruction.</p> <ul style="list-style-type: none"> ■ The operator can select one of the ready-made messages stored. ■ Any message which the operator cannot select; the operator can create any message through the keyboard.
VMS Priority Management Function	
1.	<ul style="list-style-type: none"> ■ The application shall be able to set the target link and area of each VMS for information provision. ■ The application shall be able to automatically make a priority on the incident information to be provided by VMS based on the seriousness of incidents and the distance between the incident location and the VMS locations. ■ The application shall be able to automatically transmit the incident information to be displayed on the VMS based on the pre-defined priority.
Traffic Situation Analysis Function	
1.	<ul style="list-style-type: none"> ■ The application shall be able to automatically associate the certain traffic situation such as traffic congestion etc. and the causal factors from identified traffic incidents. e.g., “Traffic Congestion” caused by “Car Accident”
Incident Management Flow Function	
1.	<ul style="list-style-type: none"> ■ The application shall be able to provide the management flow, activity, party to be communicated such as hospital etc., and report/approved to/by, contact information to the operator. ■ The application shall make it possible for the operator confirm the status of the management flow. ■ All activity shall be logged ■ The application shall make it possible for operators to create/adjust and pre-set process flows. ■ Follow can be added and modified by easy operation by operator ■ The application shall be able to keep active status from the utterance to resolve of the incident.

4.3 Functional Requirements of Information Sharing Module

The functional requirements of the information sharing module are shown the table below.

Table 4-4: Functional Requirements of Information Sharing Module

No.	Requirements
Data Integration with Related Systems	
1.	<p>ICCC System (GCC)</p> <ul style="list-style-type: none"> ■ The application shall be able to collect required data from ICCC shared location and integration at data level. ■ The application shall be able to receive the Disaster information, Flood information etc. from ICCC System. ■ The application shall be able to provide the traffic information to the ICCC System.
2.	<p>CPRR</p> <ul style="list-style-type: none"> ■ The application shall be able to connect to the CPRR System for the data integration. ■ The application shall be able to receive the traffic information (ATCC, Travel time, accident etc) from CPRR Server. ■ The application shall be able to provide the traffic information to CPRR Server.

3.	<ul style="list-style-type: none"> ■ The application shall be capable to exchange the data with any other Agency as and when required by the Employer ■ The protocol for integration with related system shall be according to the certified standard in India approved by Engineer.
Information Sharing with Related Agencies	
1.	The application shall be able to disseminate the archived traffic data to any related governmental agencies. In order to achieve this, the system shall generate the exchange data in standard data format such as XML etc..
2.	In order to use historical traffic data /information accumulated in the TIMS CCC, Information available can be shared with other designated public agencies such as PWD, Tamil Nadu Highway Department, NHAI and any other relevant agencies as per the protocol set by the Employer. This data shall be made available on application through a web portal or via an API service .
3.	Contractor shall ensure that the application developed is easily to share data and collect data. The standards should at least comply with the published e-Governance standards, frameworks, policies and guidelines in India.
Traffic Information Provision to Road Users	
1.	The application shall provide road, traffic and other traffic related information collected and processed in the probe processing module to road users in the graphical way via an internet application. The Contractor shall propose the Mobile application and the portal web site for this purpose.
2.	A map-based and easy-to-use interface shall be provided. It shall display a consolidated view of city traffic condition including the traffic status, events and weather conditions, symbolic facility, major junction etc.
3.	<p>The map-based display shall cover the entire city and be able to enlarge individual locations on the map when selected. The enlarged view shall be able to display all the details for each selected location. The information to be displayed on the map and the enlarged view shall include but not limited to the following.</p> <ul style="list-style-type: none"> ■ Traffic information on map (congestion Level by color-coded) ■ Travel time between selected locations by user ■ Event information on map (Accident construction, event etc) ■ Traffic regulation on map (Closure of road, etc) <p>As for the event information, when clicking the mark of the event, then detailed information shall be shown in the display.</p>
Data Analysis	
1.	<p>Statistical Analysis</p> <p>Historical traffic data including ATCC, Probe analyzed data, traffic status, weather condition, construction condition, regulation and incident etc for every road segment is accumulated in database as a Big Data for analyzing. This data is delivered via a product called Traffic Stats, available through a web portal or via an API service.</p> <p>Application shall provide a huge resource for Authorities and planning organizations to understand baseline conditions, evaluate the impact of changes to road policy, road infrastructure or travel demands over time.</p> <p>The Contractor shall propose an effective analysis tool in the Technical Proposal.</p>
2.	<p>Evaluation of Effectiveness</p> <p>Evaluation of effectiveness is to analyze the future road situation by considering alternative possible scenarios.</p> <p>The application shall make it possible for operators to set road traffic plans (ex. to help their decision making for newly installation of CITS Project facilities such as VMS etc. or effect</p>

	<p>of Traffic Diversions or allowing U- turns in a Junction. etc) in the system. The application shall be able to analyze the effects on the road traffic situation and generate the several scenarios on improving the traffic control accordingly.</p> <p>For example, the output of the evaluation of effectiveness of RLVD is that after RLVD implementation how violation has come down, corridor wise how it varies, which intersection violation is high, is the system meeting the KPI we defined, etc.</p>
Data Archive	
1.	<p>Historic traffic data including ATCC, Probe analyzed data, traffic status and incident for every road segment is accumulated in database as a Big Data for analyzing. This data shall be made available on application through a web portal or via an API service.</p> <p>Application shall provide a huge resource for Authorities and planning organizations to understand baseline conditions, evaluate the impact of changes to road policy, road infrastructure or travel demands over time.</p> <p>Items of data to be archived are as follows:</p> <ul style="list-style-type: none"> (1) Traffic Data collected by ATCC 2 (Traffic classification data) (2) Traffic Data processed by Probe System (Link based/section-based traffic data) (3) Incident Data registered by Operators (Incident type, location, time etc.) (4) Displayed Data on VMS (Effective factor for traffic such as weather information, regulation, construction etc) (5) Traffic Data collected by ATCS <p>The data shall be archived in the local data storage.</p> <p>The data shall be archived for at least 10 years</p> <p>The data shall be escaped to another HDD periodically (once a month at least) by the O&M Contractor for a backup.</p>

4.4 Functional Requirements of Probe Processing Module

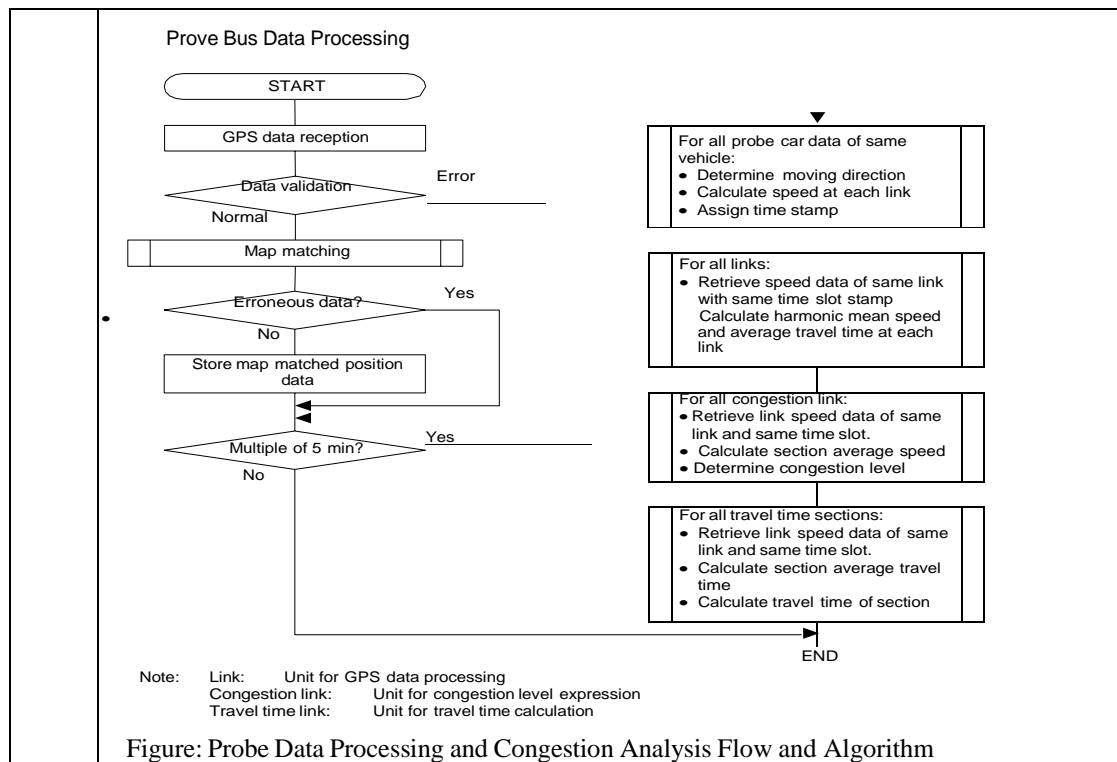
The functional requirements of the probe processing module are shown the table below.

Table 4-5: Functional Requirements of Probe Processing Module

Requirements	
Basic Function	
1.	<p>The system shall be capable of receiving bus location data from CAD/AVL system in real-time in the protocol, format and timing as specified by CAD/AVL. And ATCC system</p> <p>The probe server shall have enough processing power and storage capacity to handle the bus location data, ATCC data and produce required traffic condition information in a timely manner without delay.</p> <p>The system shall be able ready to integrate taxi probe or any other required probe data in later stage of project.</p> <p>The system shall have a digital road map database of the area covered by MTC bus service in the format suitable for processing bus location data and creating traffic condition information.</p> <p>In the digital road map data, road network shall be divided into links. Link shall be the smallest unit comprising the road network having uniform characteristics for road traffic. Separate link shall be defined for road link section in opposite direction.</p> <p>The location of bus stops shall be considered in the processing of the bus location data and in such a way to minimize the effect of delay of bus caused by boarding and alighting operation at bus stops or in depo during nonoperational mode.</p>
Tracking Data Receiving Function	

2.	<p>The bus location data is generated at an interval of 10 seconds in each GPS device on board bus. The probe system shall receive all bus location data as they are sent from buses. The data includes the following items:</p> <ul style="list-style-type: none"> ■ Device ID, ■ Bus type, ■ Location (Longitude and Latitude), ■ Date & time of data, ■ Bus route number, ■ Speed <p>More detailed structure of the GPS data will be provided to the Contractor.</p>
Data Validation Function	
3.	<p>The system shall scrutinize the data received and any abnormal data such as data without time stamp, data value outside of the range, and data with longitude and latitude outside of the bus service coverage area shall be removed from the data.</p>
Map Matching Function	
4.	<p>The system shall have map matching function to project the location of bus onto the nearest point along the bus route. If the distance between original point and projected point is longer than the pre-set threshold, the data shall be disregarded. The system shall have multiple thresholds to be applied to the different location along the bus route such as central business district and suburbs.</p>
Determination of Moving Direction Function	
5.	<p>At every traffic condition calculation cycle, the system shall process a set of location data received since the last calculation cycle and re-arrange the data in the sequence of the time stamp in the data. Then the system shall determine the direction of movement to segregate the data of opposite direction.</p>
Link speed calculation function	
6	<p>Vehicle speed of link shall be calculated using the location data of same vehicle. If there are two or more sets of data of the same vehicle in a link, vehicle speed shall be calculated using the first and last data within the link. If there is only one set of data, the data at upstream link shall be used to calculate the speed. If there is no data in a link, vehicle speed shall be marked as “not available”. In calculating vehicle speed, the distance along the road alignment shall be used and the linear distance between two points shall not be used unless link is a straight section connecting the two points. The system shall not use the speed data sent from the GPS device.</p> <p>The speed data shall be assigned with a time slot stamp based on the time when the location data is recorded by GPS device. This is necessary to process the series of data in correct order and time, as they are received in wrong sequence due to delay in data communication based on mobile network.</p>
Mean link speed and link average travel time function	
7	<p>The vehicle speed data of the same link and same time slot shall be processed, and average speed shall be calculated. The average speed shall be the harmonic mean of the speeds. Likewise, average travel time of each link shall be calculated using the link length and the average speed calculated.</p> <p>The number of data used to calculate the average speed shall be recorded together with the average speed data to indicate the number of data used for the calculation. It shall be possible to exclude the link with the number of data fewer than required in the calculation of link section congestion level and link section travel time described below.</p>
Link Section Congestion Level Function	
8	<p>Congestion level of each link shall be determined by comparing the average speed with the thresholds. Traffic condition shall be classified into three levels; no congestion, congested, heavily congested using two thresholds that separate the congestion levels. The threshold shall</p>

	<p>be a system parameter and adjustable.</p> <p>Traffic condition of the link section shall then be determined based on the link congestion level. The procedure shall consider the length and location of the links comprising the section. The application shall be able to create event of heavy congestion by probe system in consideration of traffic data at intersection by ATCS.</p>																																
Link Section travel time Function																																	
9	<p>The system shall calculate the travel time of link section based on the travel time and length of links comprising the link section. The link section for congestion level and link section for travel time shall be defined independently each other.</p>																																
Supporting Function for Traffic Planning Function																																	
10	<p>Objectives:</p> <p>This function is offering visualizing data by using historical data from probe system.</p> <p>To assist clear and fast understanding, historical data should be offered with visualization.</p> <p>Functions:</p> <p>Calculating the speed and travel route using probe data.</p> <p>Calculating and display as following table Between two intersections using probe data.</p> <table><tr><th>Item</th><th>Contents</th><th>Graphic</th><th>List</th></tr><tr><td>Traffic condition</td><td>Current average speed (between two intersections)</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr><tr><td></td><td>Number of vehicles per unit of time</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr><tr><td></td><td>Average time of passing intersection</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr><tr><td></td><td>Congestion level of intersections</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr><tr><td></td><td>Average travel time of sections</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr><tr><td></td><td>Ranking of data (duration time, number of vehicles) ordered by parameter (time{ On Peak, Off Peak }, day{ Weekday, holiday, day }, duration{ 1 month, 3 month, a half year, one year }) etc.</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr><tr><td></td><td>Average travel time of radiation direction</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr></table>	Item	Contents	Graphic	List	Traffic condition	Current average speed (between two intersections)	<input type="checkbox"/>	<input type="checkbox"/>		Number of vehicles per unit of time	<input type="checkbox"/>	<input type="checkbox"/>		Average time of passing intersection	<input type="checkbox"/>	<input type="checkbox"/>		Congestion level of intersections	<input type="checkbox"/>	<input type="checkbox"/>		Average travel time of sections	<input type="checkbox"/>	<input type="checkbox"/>		Ranking of data (duration time, number of vehicles) ordered by parameter (time{ On Peak, Off Peak }, day{ Weekday, holiday, day }, duration{ 1 month, 3 month, a half year, one year }) etc.	<input type="checkbox"/>	<input type="checkbox"/>		Average travel time of radiation direction	<input type="checkbox"/>	<input type="checkbox"/>
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	Average travel time of radiation direction	<input type="checkbox"/>	<input type="checkbox"/>																														



Display Function

- 11 It shall be possible to display in real-time link section speed as determined by the processing described above on the operator console and in printed form. Both numerical and graphical presentation of the data shall be provided. The data on the display shall be automatically updated as the traffic condition is updated.

Data Storage and Retrieval Function

- 12 All data transmitted from the MTC bus probe system and processed data in the TIMS shall be recorded and stored in the probe server for analysis and future usage. The raw bus location data sent from GPS device and processed location data after map matching shall be kept for three (3) months, while 5-minute link, speed, link section congestion level and link section travel time data shall be kept permanently.
- Data retrieval and presentation software shall be provided that shows the original location data, location data after map matching, link section congestion level and link section speed data. Graphical presentation of historical section congestion level and section travel time data such as hourly variation and daily variation shall also be available.
- Traffic volume information edited and processed is counted in 1 hour, day, month, and saved for a certain period (over 1 year) file. Data older than the retention period will be deleted in order of old data, and old data can be stored in the storage device etc. of the TIMS Server. In addition to the above data, it should also store information necessary for system operation. The saved information should be able to provide file output (MS Excel etc.).

Sub-system	Data	Interval/Timing
Probe system	Bus location data received	Upon reception
	Bus location data after map matching	Upon processing
	Link speed	5 min.
	Link Section congestion level	5 min.
	Link Section travel time	5 min.

Monitoring Function			
13	The information monitoring shall be map based (Schematic map and GIS map) interface and as well in the form of a list. The schematic map-based display shall cover the entire GCC area and be able to enlarge individual locations on the map when selected. The enlarged view shall be able to display the details for each selected location. The details displayed shall cover notbe limited to the contents described in the Table below.		
	Item	Contents	GraphicList
	Traffic condition	Current average speed (link section)	<input type="checkbox"/> <input type="checkbox"/>
		Current travel time (link section)	<input type="checkbox"/>
	Probe data	Probe data	<input type="checkbox"/>
		Location and speed level of time period specified	<input type="checkbox"/>
	Parameter	Parameters for viewing and editing	<input type="checkbox"/> <input type="checkbox"/>
	Traffic condition	Current average speed (between two intersections)	<input type="checkbox"/> <input type="checkbox"/>
		Number of vehicles per unit of time	<input type="checkbox"/> <input type="checkbox"/>
		Average time of passing intersection	<input type="checkbox"/> <input type="checkbox"/>
		Congestion level of intersections	<input type="checkbox"/> <input type="checkbox"/>
		Average travel time of sections	<input type="checkbox"/> <input type="checkbox"/>
		Ranking of data (duration time, number of vehicles) ordered by parameter (time {On Peak, Off Peak}, day{ Weekday, holiday, day }, duration{ 1 month, 3 month, a half year, one year }) etc.	<input type="checkbox"/> <input type="checkbox"/>
		Average travel time of radiation direction	<input type="checkbox"/> <input type="checkbox"/>
Reporting Function			
14	The Probe Server shall publish / print as a minimum the reports listed below. The reports shall be produced as pre-scheduled or on-demand by system operator. It shall be possible to produce the reports in a portable file format.		
	Item	Contents	
	Traffic conditions	Daily report containing hourly link sectional average speed Monthly report containing daily link sectional average speed and that of the day of the week	
	Operation and error log	List of roadside equipment those are operational or malfunctioned Error record	
Data Transmitting Function			
15	Following data processed in the Probe Server shall be stored at an interval of 5 minutes in the database of Traffic Information System for total system management.		
	■ 1-minute link sectional average speed		
	■ “n” minutes link sectional average speed (default “n” = 5 minutes)		
	■ Traffic congestion analysis results with parameters		
	■ Travelling time in each link		
	■ Travelling speed in predetermined link section with parameters		
	■ Equipment operational status		

4.5 Functional Requirement of Common Function Module

Table 4-6: Functional Requirement of Common Function Module

No.	Requirements
Solution and Platform	
1.	<ul style="list-style-type: none">■ The software/Application must not be restricted by the license term of OEM from scaling out on unlimited number of cores and servers during future expansion for application, database any other.■ The platform should be able to normalize the data coming from different devices of same type Application servers and provide secure access to that data using data API(s) to application developers/external agencies■ System shall have the provision for integration of various services and be able to monitor them and operate them. The solution should provide option to integrate existing deployed solution by City and need to provide scalability option to implement new use cases.
Standard for Application	
2.	<ul style="list-style-type: none">■ System shall have the provision for integration of various services and be able to monitor them and operate them. The solution should provide option to integrate existing deployed solution by city at data level and need to provide scalability option to implement new use cases.■ System shall have capability to source data from various system existing in Chennai city for traffic and incident information
Dashboard	
3.	<ul style="list-style-type: none">■ Collect major information from other resource for analysis and show on map (Schematic map and GIS map)■ Multi-displays configurations■ The system should be able to show, create, assign, track and report task life cycle automatic for detected incident.
Information Monitoring	
4.	<ul style="list-style-type: none">■ The purpose of ITMS is to have an integrated view of all the applications related to traffic and enforcement undertaken by Chennai Traffic Police (CTP) and line department with the focus to serve as a decision support engine in day-to-day operations or during exigency situations.■ ITMS shall enable different systems and departments of Chennai to monitor and utilize information of other departments for delivering services in an integrated and more efficient manner.■ ITMS shall Integrate all subsystems of TIMS to a central map of Schematic map and GIS platform.■ ITMS shall provide real time dashboards, visualizations, KPIs, historical trending, analytics and other intelligent features to facilitate city operations analysis by. It provides alarm features for immediate notification to TIMS level in case critical events occur in the city and Manage event & incident data.■ ITMS comprises a centralized integrated dashboard for entire Chennai city for the reporting and viewing of all the project components and key performance indicators of systems through a single interface. All information collected & saves into centralized database & used this information for city administration in a combined platform to view whole city in one go with the measurable parameter.■ ITMS must view traffic data monitoring, weather data monitoring, various messaging signs control, incident detection, incident response,■ ITMS shall provide a holistic and real time view of all city operations on a video wall

	<p>along with individual views on operator workstations. It enables monitoring, control, and automation of various city operations in order to ease and organize city operations.</p> <ul style="list-style-type: none"> ■ ITMS must show the use cases such as Traffic congestion, Traffic diversion, Signal Priority, accidents & Incidents, user information dissemination, all types of defined Violations such as Red light, stop line, unauthorized U-turn, wrong direction, unauthorized stopping, signal jumping, Speed violations etc. ■ ITMS must show the warning information such as high traffic congestion, critical accident zone etc. The application must seed the vehicle position tracking, Geofencing & alert for over speeding vehicle as well as Red-light violating vehicle. ■ ITMS must be capable to view dashboard having customized displays, current alarms, meaningful analysis, real time and historical reporting using Business Intelligent (BI) tools. The Data analytics/BI tool should have ability to analyze the useful information and sharing it with general public. ■ ITMS must be capable of Forward-looking decision making – BI and analytics tool provide the predictive and forecasting capabilities which can help department in forward looking policy and decision making. ■ ITMS must be Customizable and programmable Event Response Mechanism to manage all the Event Response Mechanisms and must be customizable based upon functional parameters like criticality, region, access, automatic/manual etc. but not limited to these four. Dashboards generated by the system (functional / technical) must be customizable based upon the user's requirements. The operator system must remember the edits done by the user to his/her own dashboard when he/she logins next time in the system without disturbing the main view. ■ The ITMS application must have capabilities to show the Hot Calls alert. Once a Location of the incident is marked in the map, the operator must have the facility to see for various 'Location of Interest (LOI)' in the vicinity of an event location like nearest Hospital, Blood Bank, Fire brigade, etc. ■ All services of various solutions available on single platform. ■ Safe Secure and CITS operation with Alarm and Events Notification. ■ Map based Operation and Response. ■ Minimal human intervention for operation. ■ Provide support for decision making with data with graphs. ■ Predefined and customized SOPs to manage city civic operation
GIS Platform	
1.	<p>One of the goals of the Traffic and Transport is to create a single interface to show integrated view on a GIS platform. GIS platform shall have high quality map view, and which shall support multiple level of layers. GIS platform shall be customized to provide clear view to the stakeholders.</p> <ul style="list-style-type: none"> ■ Use GIS system as a backbone for the Chennai traffic network. ■ Collaboration of various city stakeholders & departments together and to have a connect and engagement via a common GIS window for all operations ■ Use GIS as spatial planning and analysis for various operation within city ■ Use GIS as a Decision support system to prioritize actions ■ To have a location-based services to citizens of Chennai for better transparency & quick actions ■ GIS based spatial and non-spatial queries for citizens and administrators and departmental stakeholders ■ GIS map data can be updated timely by easy operation (GIS Map data to be provided by another party. Cost for update shall be paid by the Contractor.

Database Management																																																		
1.	<ul style="list-style-type: none"> ■ The ITMS platform shall store the raw and processed data in a database management system (DBMS) for statistical use in traffic management and road planning. The system shall have one centralized database for managing the entire System. Parameters such as type, quantity, and time period of data to be stored in the database shall be configurable. All data shall have a time stamp of recording. ■ The Contractor shall provide the licensed latest version of SQL based Relational Database Management System (RDBMS) such as Oracle, SQL Server, DB2 and/or equivalent as part of the contract. The Contractor shall submit the detailed database architecture as part of the Technical Proposal. <table border="1"> <thead> <tr> <th>Sub-System</th><th>Storage Data</th><th>Interval/Timing</th></tr> </thead> <tbody> <tr> <td rowspan="4">ATCC-1 System</td><td>Traffic volume (small vehicles)</td><td>5 Min./ 1Hour/ 24 Hours</td></tr> <tr> <td>Traffic volume (large vehicle)</td><td>5 Min./ 1Hour/ 24 Hours</td></tr> <tr> <td>Average speed</td><td>5 Minutes</td></tr> <tr> <td>Equipment status</td><td>Upon status change</td></tr> <tr> <td rowspan="3">ATCC-2 System</td><td>Traffic volume (all types specified)</td><td>5 Min./ 1hour/ 24 hours</td></tr> <tr> <td>Average speed</td><td>5 Minutes</td></tr> <tr> <td>Equipment status</td><td>Upon status change</td></tr> <tr> <td rowspan="3">Probe System</td><td>GPS data</td><td>Upon reception</td></tr> <tr> <td>Average speed at each link/section</td><td>5 Minutes</td></tr> <tr> <td>Number of data for each link/section</td><td>5 Minutes</td></tr> <tr> <td rowspan="3">VMS System</td><td>Message display log</td><td>Upon display change</td></tr> <tr> <td>Manual input operation log</td><td>Upon manual operation</td></tr> <tr> <td>Equipment operational status</td><td>Upon status change</td></tr> <tr> <td>ATCS System</td><td>Traffic data collected by detector, including Que length, Speed and occupancy Que length, Average Speed</td><td>5 Minutes</td></tr> <tr> <td>RLVD System</td><td>Violation detail with evidence, Log, Vehicle Image & video,</td><td>5 Minutes</td></tr> <tr> <td>SLVD System</td><td>Violation detail with evidence ,Log, Vehicle Image & video ,</td><td>5 Minutes</td></tr> <tr> <td>TIDS System</td><td>Incident Detected including ,Alert, evidence, Logs</td><td>1 Minutes</td></tr> <tr> <td>Others</td><td>Access history of Web</td><td>Upon access</td></tr> </tbody> </table> <p>The Contractor shall provide the database on status of all equipment. Items to be monitored are as follows: live monitoring (Common) Message displayed on VMS (VMS system)</p>	Sub-System	Storage Data	Interval/Timing	ATCC-1 System	Traffic volume (small vehicles)	5 Min./ 1Hour/ 24 Hours	Traffic volume (large vehicle)	5 Min./ 1Hour/ 24 Hours	Average speed	5 Minutes	Equipment status	Upon status change	ATCC-2 System	Traffic volume (all types specified)	5 Min./ 1hour/ 24 hours	Average speed	5 Minutes	Equipment status	Upon status change	Probe System	GPS data	Upon reception	Average speed at each link/section	5 Minutes	Number of data for each link/section	5 Minutes	VMS System	Message display log	Upon display change	Manual input operation log	Upon manual operation	Equipment operational status	Upon status change	ATCS System	Traffic data collected by detector, including Que length, Speed and occupancy Que length, Average Speed	5 Minutes	RLVD System	Violation detail with evidence, Log, Vehicle Image & video,	5 Minutes	SLVD System	Violation detail with evidence ,Log, Vehicle Image & video ,	5 Minutes	TIDS System	Incident Detected including ,Alert, evidence, Logs	1 Minutes	Others	Access history of Web	Upon access	
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	Average speed	5 Minutes																																																
	Equipment status	Upon status change																																																
ATCC-2 System	Traffic volume (all types specified)	5 Min./ 1hour/ 24 hours																																																
	Average speed	5 Minutes																																																
	Equipment status	Upon status change																																																
Probe System	GPS data	Upon reception																																																
	Average speed at each link/section	5 Minutes																																																
	Number of data for each link/section	5 Minutes																																																
VMS System	Message display log	Upon display change																																																
	Manual input operation log	Upon manual operation																																																
	Equipment operational status	Upon status change																																																
ATCS System	Traffic data collected by detector, including Que length, Speed and occupancy Que length, Average Speed	5 Minutes																																																
RLVD System	Violation detail with evidence, Log, Vehicle Image & video,	5 Minutes																																																
SLVD System	Violation detail with evidence ,Log, Vehicle Image & video ,	5 Minutes																																																
TIDS System	Incident Detected including ,Alert, evidence, Logs	1 Minutes																																																
Others	Access history of Web	Upon access																																																
Data Collection																																																		
	<ul style="list-style-type: none"> ■ ITMS shall have feature of data completeness in case any data is missing or did not synchronize on server due any malfunction then system shall be generating alert and clearly mention on reports and log as “Data Incomplete”. ■ Transaction number, incident number, Image, Video and Log number etc, shall be in sequency and unique after go live, It also shall be sync with server and always generate at LPU level. 																																																	
System Monitoring																																																		
2.	<ul style="list-style-type: none"> ■ The ITMS platform shall have a system management function to monitor the operational condition of roadside equipment and sub-system equipment. The system management 																																																	

	<p>function shall monitor the operation status of all the sub-system components.</p> <ul style="list-style-type: none"> ■ This function shall consolidate the status monitoring of each sub-system component, present the status to operators and record the system operation. When any abnormality or malfunction is detected, the ITMS platform shall issue an alarm providing the type and location of the failure so that remedial action can be taken. The event shall be recorded in the sub-system operation log. Database storage shall have a capacity of 2 years for recording the operation log. ■ Call log function, SLA calculation function and reporting function shall be provided.
Network Management and Control	
3.	<ul style="list-style-type: none"> ■ The network management function shall be provided to the system and the function shall continuously monitor the Level 2 switch and Level 3 switch using Simple Network Management Protocol (SNMP). In case of identification of a malfunction, network management system shall issue an alarm to the operator console and at the same time store the malfunction record in the network operation log. ■ Database storage shall have a capacity of 2 years for recording the operation log. ■ SLA calculation and reporting function shall be provided.
Parameter Monitoring and Modification	
4.	<ul style="list-style-type: none"> ■ Various parameter exists in TIMS to define the system configuration and process gathered data. These parameters shall be configurable or adjustable to redefine the system configuration and tune the system operation. The Central Server shall be provided with parameter monitoring and modification function through the screen forms. In order to prevent inadvertent modification of parameter, access level shall be assigned to the parameter and the system parameters that defines the system configuration shall be given the highest access level. ■ Each server shall have the same parameter monitoring and modification function of the parameter used for each sub-system. Means shall be provided to prevent contradictory parameter setting by different servers. Modification of the system parameters shall be possible only through the ITMS platform. However, the parameter of the roadside equipment shall be modified through each server.
Report Compilation and Printing	
5.	<ul style="list-style-type: none"> ■ The ITMS platform shall have a reporting functionality by which various daily, monthly, and annual reports can be printed. ■ The reports shall be produced in two modes, automatic and on-demand. In automatic mode, each report shall be printed automatically at the specified time and in on-demand mode, report is printed when the operator requests for it. ■ The data storage period is assumed to be about 10 years, and it can be transferred to a storage device for storage. In addition to the above data, it also stores information necessary for system operation. It is assumed that the saved information can be output (MS Excel etc.) from the operator console. ■ The reports shall be provided in vernacular language.

4.6 Functional Requirement of Enterprise Management System (EMS)

Table 4-7: Functional requirement of Enterprise Management System (EMS)

No.	Requirements
ENTERPRISE MANAGEMENT SYSTEM (EMS)	
Network Management and Control	
1	<ul style="list-style-type: none">■ The network management function shall be provided to the system and the function shall continuously monitor the Level 2 switch and Level 3 switch using Simple Network Management Protocol (SNMP). In case of identification of a malfunction, the network management system shall issue an alarm to the operator console and at the same time store the malfunction record in the network operation log.■ Database storage shall have a capacity of 2 years for recording the operation log.■ SLA calculation and reporting function shall be provided.■ The proposed system shall support multiple types of discovery like IP range discovery – including built-in support for IPv6, Seed router-based discovery, and discovery whenever new devices are added with the capability to exclude specific devices.■ The proposed system shall support the exclusion of specific IP addresses or IP address ranges.■ The proposed solution shall provide a detailed asset report, organized by proper naming of all devices, listing all ports for all devices. The proposed system shall provide sufficient reports that identify unused ports in the managed network infrastructure that can be reclaimed and reallocated.■ The proposed solution shall determine device availability and shall exclude outages from the availability calculation with an option to indicate the reason.■ The proposed solution shall provide the box root cause analysis.■ The proposed solution shall have an integrated user-friendly application.■ The proposed solution shall include all required licenses.■ The proposed solution shall provide real-time monitoring of the entire network infrastructure and shall allow users to easily navigate with a graphical interface and easy-to-use network management tools.■ The proposed solution shall provide at a minimum, event alert via the existing Microsoft Exchange Server email or pop-up alarm or export to CSV.■ The proposed solution shall automatically generate reports on a daily, weekly, and monthly basis in formats including graphs, bar charts, distribution, and summary. The system shall be capable of printing out reports and also exporting the reports to other systems or web servers.■ The proposed solution shall display a simple map of the whole network as a tree and shall have the option of direct selection of objects. The system shall provide a navigation tree to display the current alarm status of each subnet. All the systems shall support PAN/ ZOOM feature and shall have all the devices visible in one window along with the provision for these two features■ The proposed solution shall provide polling agents to upload status, changes, or alerts of the local devices attached with the Ethernet enabling devices.■ The proposed solution shall provide real-time Management Information Bases (MIBs) displays and shall provide the MIB variable data in tabular or graphical format. The MIB displays shall provide various expressions like utilization, percentage errors, and volume■ The proposed solution shall provide features for security and accountability and shall generate a log file for any user access to configuration or platform changes.■ The proposed solution shall be capable of managing any SNMP/ICMP device from any

	<p>vendor.</p> <ul style="list-style-type: none"> ■ The proposed solution shall support SNMPV1, SNMPV2C, and SNMPV3 and shall automatically discover and poll SNMP and ICMP devices. ■ SNMP traps for all IP-enabled devices shall be provided by the respective product manufacturers. ■ The proposed solution shall allow notifications to be automatically sent to phones, offsite workstations, etc. for efficient response. ■ The proposed solution shall monitor as a minimum the base station unit and the subscriber station units along with other IP-enabled equipment that is being provided as part of this Project. ■ The proposed solution shall allow for providing different levels of security access i.e., viewing, logging and managing. ■ The proposed solution shall allow for the display of different colors for the links including red, green, orange, yellow to show the status of the links and the connected devices ■ The operation of the NMS shall be tested while the backbone network is under 30% network utilization. ■ The proposed solution must provide an interface for IT helpdesk personnel to create guest credentials. ■ The proposed solution shall be supplied with a server with Windows or Linux-based OS (latest) or later.
Service Level - Monitoring, Management, and Reporting	
2	<ul style="list-style-type: none"> ■ The proposed service management system shall provide a detailed service dashboard view indicating the health of each of the components and services provisioned as well as the SLAs ■ The system shall provide an outage summary that gives a high-level health indication for each service as well as the details and root cause of an outage. ■ The system shall be capable of managing IT and Non-IT resources in terms of the business services they support, specify and monitor service obligations, and associate users/Departments/ Organizations with the services they rely on and related Service/Operational Levels Agreements. Presently, services shall include E-mail, Internet Access, Intranet, and other services hosted. ■ SLA violation alarms shall be generated to notify whenever an agreement is violated or is in danger of being violated. These alarms shall be automatically shared with the authorized people. ■ The system shall provide the capability to designate planned maintenance periods for services and take into consideration maintenance periods defined at the IT resources level. In addition, the capability to exempt any service outage from impacting an SLA shall be available. ■ The reports supported shall include one that monitors service availability (including Mean Time to Repair (MTTR), Mean Time Between Failure (MTBF), and Maximum Outage Time thresholds) and the other that monitors service transaction response time. ■ The system shall provide a historical reporting facility that shall allow for the generation of on-demand and scheduled reports of Service-related metrics with capabilities for customization of the report presentation.
Application Performance - Monitoring, Management, and Reporting	
3	<ul style="list-style-type: none"> ■ The proposed solution shall proactively monitor all user transactions for any web application hosted; detect failed transactions; gather evidence necessary for triage and diagnosis of problems that affect user experiences and prevent completion of critical business processes.

	<ul style="list-style-type: none"> ■ The proposed solution shall determine if the cause of performance issues is inside the application, in connected back-end systems, or at the network layer. ■ The proposed solution shall correlate performance data from HTTP Servers (external requests) with internal application performance data. ■ The proposed solution shall see response times based on different call parameters. For example, the proposed solution shall be able to provide CPU utilization metrics. ■ The proposed solution shall allow data to be seen only by those with a need to know and limit access by user roles. ■ The solution shall be deployable as an appliance or physical or virtual server-based system acting as an active/passive listener on the network thus inducing zero overhead on the network and application layer. ■ The proposed solution shall be able to provide the ability to detect and alert which exact end-users experience HTTP error codes such as 404 errors or errors coming from the web application. ■ The proposed system shall be able to detect user-impacting defects and anomalies and reports them in real-time for Slow Response Time, Fast Response time, Low Throughput, Partial Response, Missing component within the transaction. ■ The proposed system shall be able to instantly identify whether performance problems like slow response times are within or outside the Datacenter without having to rely on network monitoring tools.
Systems and Database Performance - Monitoring, Management, and Reporting	
4	<ul style="list-style-type: none"> ■ The proposed system shall address management challenges by providing centralized management across physical and virtual systems. ■ The proposed system shall be able to monitor various operating system parameters such as processors, memory, files, processes, file systems, etc. where applicable, using operators on the servers to be monitored. ■ It shall be possible to configure the operating system monitoring operators to monitor based on user-defined thresholds for warning/critical states and escalate events to the event console of the enterprise management system. ■ It shall also be able to monitor various operating system parameters depending on the operating system being monitored yet offer a similar interface for viewing the operators and setting thresholds. ■ The proposed solution shall support monitoring Processors, File Systems, Log Files, System Processes, and Memory, etc. ■ The proposed tool shall provide Process and NT Service Monitoring wherein if critical application processes or services fail, administrators are immediately alerted, and processes and services are automatically restarted. ■ The proposed tool shall be able to provide Log File Monitoring which enables the administrator to watch system logs and text log files by specifying messages to watch for. When matching messages get logged, the proposed tool shall notify administrators and enable them to take action like sending an email. ■ The proposed database performance management system shall integrate network, server & database performance management systems and provide a unified view of the performance state in a single console. ■ It shall be able to automate monitoring, data collection, and analysis of performance from a single point. ■ It shall also provide the ability to set thresholds and send notifications when an event occurs, enabling Database Administrators (DBAs) to quickly trace and resolve performance-related bottlenecks. ■ Role-based Access — Enables role-based management by defining access privileges according to the role of the user.

	<ul style="list-style-type: none"> ■ The proposed Virtual Performance Management system shall integrate the latest virtualization technologies.
Helpdesk - Monitoring, Management, and Reporting	
5	<ul style="list-style-type: none"> ■ The proposed helpdesk system shall provide flexibility of logging, viewing, updating, and closing incident manually via the web interface. ■ The proposed helpdesk system shall support ITIL processes like request management, problem management, configuration management, and change order management with out-of-the-box templates for various ITIL service support processes. ■ Each incident shall be able to associate multiple activity logs entries via a manual update or automatic update from other enterprise management tools. ■ The proposed helpdesk system shall be able to provide flexibility of incident assignment based on the workload, category, location, etc. ■ Each escalation policy shall allow easy definition on multiple escalation levels and notification to different personnel via window GUI/console with no or minimal programming. ■ The proposed helpdesk system shall provide grouping access to different security knowledge articles for different groups of users. ■ The proposed helpdesk system shall have an updatable knowledge base for technical analysis and further help end-users to search for solutions for previously solved issues. ■ The proposed helpdesk system shall support tracking of SLA (Service Level Agreements) for call requests within the help desk through service types. ■ The proposed helpdesk system shall be capable of assigning call requests to tech al staff manually as well as automatically based on predefined rules, and shall support notification and escalation over email, web, etc. ■ The proposed helpdesk system shall integrate tightly with the knowledge tools and CMDB and shall be accessible from the same login window. ■ It shall allow the IT team to create solutions & make them available on the end-user login window for the most common requests. ■ The helpdesk shall be a web-enabled management system with an SMS and email-based alert system for the Helpdesk Call management and SLA reporting. ■ The Help desk shall log user calls related to the system and assign an incident/ call ID number. Severity shall be assigned to each call as per the SLAs. ■ Helpdesk shall track each incident/call to resolution. Escalate the calls, to the appropriate levels, if necessary, as per the escalation matrix agreed upon with Authority/authorized entity.
Traffic Analysis through EMS	
6	<ul style="list-style-type: none"> ■ The traffic analysis system shall be from the same OEM providing Network Fault & Performance Management System. ■ The tool shall support Flow monitoring and traffic analysis for NetFlow, J-Flow, sFlow, Netstream, IPFIX technologies. ■ The solution shall provide a central web-based integration point across any of the flow protocols and shall be able to report from a single console. ■ The solution shall be of passive-type and should not cause any performance overheads.
Incident Management and Root Cause Analysis Reporting	
7	<ul style="list-style-type: none"> ■ An information security incident is an event (or chain of events) that compromises the confidentiality, integrity, or availability of information. All information security incidents that affect the information or systems of the enterprise (including malicious attacks, abuse/misuse of systems by staff, loss of power/communications services, and errors by users or computer staff) shall be dealt with following a documented information security

	<p>incident management policy</p> <ul style="list-style-type: none"> ■ Incidents shall be categorized and prioritized. While prioritizing incidents the impact and urgency of the incident shall be taken into consideration. ■ It shall be ensured that the incident database is integrated with the Known Error Database (KeDB), Configuration Management Database (CMDB). These details shall be accessible to relevant personnel as and when needed. ■ Testing shall be performed to ensure that recovery action is complete and that the service has been fully restored. ■ When the incident has been resolved, it shall be ensured that the service desk records of the resolution steps are updated and confirm that the action taken has been agreed to by the end-user. Also, unresolved incidents (known errors and workarounds) shall be recorded and reported to provide information for effective problem management. ■ Information security incidents and weaknesses associated with information systems shall be communicated in a manner allowing timely corrective action to be taken
Change and Configuration Management	
8	<ul style="list-style-type: none"> ■ Change management provides information on changes and enables better control of changes to reduce errors and disruption in services. ■ All changes shall be initiated using a change management process, and a Request for Change (RFC) shall be created. All change requests shall be evaluated to determine the impact on business processes and IT services and to assess whether change shall adversely affect the operational environment and introduce unacceptable risk. ■ All changes are logged, prioritized, categorized, assessed, authorized, planned, and scheduled to track and report all changes. All the logs should be immutable. ■ Ensure review of changes for effectiveness and take actions agreed with interested parties. Change requests shall be analyzed at planned intervals to detect trends. The results and conclusions drawn from the analysis shall be recorded and reviewed to identify opportunities for improvement. ■ The roles and responsibilities of the management shall include review and approval of the implementation of change management policies, processes, and procedures ■ A configuration management database shall be established which stores unique information about each type of Configuration Item CI or group of CI. ■ The Configuration Management Database (CMDB) shall be managed such that it ensures its reliability and accuracy including control of update access. ■ The degree of control shall maintain the integrity of services and service components taking into consideration the service requirements and the risks associated with the CI. ■ Corrective actions shall be taken for any deficiencies identified in the audit and shall be reported to the management and process owners ■ Information from the CMDB shall be provided to the change management process and the changes to the CI shall be traceable and auditable. ■ A configuration baseline of the attached CI shall be taken before deployment of a release into the live environment. It shall be stored in a safe environment with appropriate access control. ■ Master copies of CI shall be recorded in the CMDB and shall be stored in secure physical or electronic libraries which shall be referenced in the configuration records. This shall apply to documentations, license information, software, and hardware configuration images. ■ The NMS shall facilitate the retrieval, storage, analysis, and display of status information from all network devices attached to the system that are SNMP and/or ICMP capable and shall facilitate remote configuration of these devices. NMS shall support both IPv4 and IPv6 device integration. ■ The NMS shall provide the ability to view the network and its associated IP SNMP/ICMP

	enabled devices including switches and other IP devices connected over the network. It shall support a minimum of 10,000 endpoints
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4.7 Functional Requirement of Call Centre

Table 4-8: Functional requirement of call centre

No.	Requirements
CALL CENTER	
1.	<p>Call center proposed system shall have minimum following parameters:</p> <ul style="list-style-type: none"> ■ For up to 20 agents ■ Automatic call distribution ■ Automatic identification of incoming number based on landline and mobile number mapping ■ Call recording for at least for 30 days or more as required ■ Call recording mapped to incident tickets ■ Customizable agent and supervisor desktop layout ■ Inbound and outbound capability ■ Call control ■ Multisession web chat ■ Email ■ Live data reporting gadgets ■ Phonebook ■ Multiline support ■ Speed dial in IP phones
Automatic Call Distribution (ACD)	
2	<ul style="list-style-type: none"> ■ Should be highly available with hot standby and seamless failover in case of main server failure. There should not be any downtime of Contact Center in case of single server failure. ■ ACD support routing of incoming calls based upon caller input to menus, real-time queue statistics, time of day, day of week, ANI, dialed number etc. ■ ACD should support call routing based on longest available agent, circular agent selection algorithms. ■ ACD should support the playing of customizable queuing announcements based upon the skill group that the call is being queued to, including announcements related to position in queue and expected delay. ■ Operator should be able to chat with another Operator or supervisor from the Operator desktop software ■ Supervisor should be able to see the real-time status of Operator. ■ Should support Queuing of calls and playing different prompts depending on the type of call and time in the queue. ■ In future if required, the ACD should support active and standby server mode, where the server can be put in DC and DR. In case of Main server in the Data center fail the standby server in DR should take over seamlessly. ACD solution should support placing of Main and Stand by server in DC and DR respectively.
Interactive Voice Response (IVR)	
1	<ul style="list-style-type: none"> ■ The IP telephony system should be a converged communication System with ability to run TDM and IP on the same platform using same software load based on server and

	<p>Gateway architecture</p> <ul style="list-style-type: none"> ■ The single IP PBX system should be scalable to support up to 150 stations (any mix/percentage of Analog/IP) to achieve the future capacity ■ The system should be based on server gateway architecture with external server running on Linux OS/Other. No card-based processor systems should be quoted ■ The voice network architecture and call control functionality should be based on SIP ■ The call control system should be fully redundant solution with no single point of failure & should provide 1:1 redundancy. ■ The communication server and gateway should support IP V6 from day one to be future proof
	<ul style="list-style-type: none"> ■ Support for call processing ■ Should support signaling standards/Protocols – SIP, MGCP, H.323, Q.Sig ■ Voice Codec support - G.711, G.729, G.729ab, g.722, ILBC ■ The System should have GUI support web-based management console ■ System shall be maintaining all call log ■ System shall be able to generate reports related to call with voice recording
	<ul style="list-style-type: none"> ■ Security ■ The protection of signaling connections over IP by means of authentication, Integrity and encryption should be carried out using TLS ■ System should support MLPP feature ■ Proposed system should support SRTP for media encryption and signaling encryption by TLS

4.8 Functional Requirement of IP-PABX System

Table 4-9: Functional requirement of IP-PABS system

No.	Requirements
IP-PABX SYSTEM	
1.	<ul style="list-style-type: none"> ■ The IP telephony system should be a converged communication System with ability to run TDM and IP on the same platform using same software load based on server and Gateway architecture ■ The single IP PBX system should be scalable to support up to 150 stations (any mix/percentage of Analog/IP) to achieve the future capacity ■ The system should be based on server gateway architecture with external server running on Linux OS/Other. No card-based processor systems should be quoted ■ The voice network architecture and call control functionality should be based on SIP ■ The call control system should be fully redundant solution with no single point of failure & should provide 1:1 redundancy. ■ The communication server and gateway should support IP V6 from day one to be future proof
2	<p>Support for call processing</p> <ul style="list-style-type: none"> ■ Should support signaling standards/Protocols – SIP, MGCP, H.323, Q.Sig ■ Voice Codec support - G.711, G.729, G.729ab, g.722, ILBC ■ The System should have GUI support web-based management console ■ System shall be maintaining all call log ■ System shall be able to generate reports related to call with voice recording.

3	Security <ul style="list-style-type: none"> ■ The protection of signaling connections over IP by means of authentication, Integrity and encryption should be carried out using TLS ■ System should support MLPP feature ■ Proposed system should support SRTP for media encryption and signaling encryption by TLS
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4.9 Functional Requirement of Website and Mobile Application

Table 4-10: Functional requirement of website and mobile application

No.	Requirements
Website	
1.	<ul style="list-style-type: none"> ■ The Contractor shall develop and maintain mobile applications for commuters. ■ The web/Mobile application shall have GIS Map and do various Analyses, like location, Speed, congestion, corridor status, traveling time point to point. ■ The web/Mobile application shall be host on the cloud and collect real-time traffic data from TIMS-CCC and offline data shall be available from the cloud server. ■ Web/Mobile site shall have functionality for registration of city users with verification of authenticated information. ■ Web Site/Mobile shall be able to show traffic flow forecasting based on historical data analytics done at the ITMS system. ■ Web Site/Mobile shall have to MAP enable function to show traffic situation on based of input data collected from ITMS. ■ Web Site/Mobile shall be used for the publication of informative information for the city commuter. ■ Web Site/Mobile and infrastructure shall be able to handle a minimum of 50,00,000 hits simultaneously ■ Required security level shall be enough to handle the threat, hacking, or any other malfunction in the future. The Contractor shall be arranged the required IT hardware and software to fullfill future requirements as the Employer desired. ■ The final design of web site shall be submitted by the Contractor for review and approval by the Engineer/Employer. ■ The change request shall be processed by the Contractor free of cost during the contract. ■ The Web Site/Mobile shall be open for integration with other data sources or government agency ■ The source code shall be the property of the Employer and the Contractor shall be maintained version control. ■ Time to Time updated source code shall be submitted, Employer with technology transfer rights
2	Home Page A clean, visually compelling home page that quickly conveys to the visitor, the CITS's mission and what CITS does. It will include (but not limited to) the following information either directly or linked through other pages: <ul style="list-style-type: none"> ■ About CSCL/CITS/CTP; Corporation, Message from the CMD, Board of Directors, Shareholding pattern, Organogram & Key Personnel ■ City Profile ■ City Traffic Forecast

	<ul style="list-style-type: none"> ■ Corridor Traffic Status ■ Key statistics ■ Tourist Locations ■ GIS map of the City ■ Photo Gallery ■ Information/Education ■ Opportunities; Empanelment, Training ■ Downloads ■ Links to Facebook, Twitter, etc. ■ FAQs ■ Feedback ■ Contact Us ■ Search ■ News & Updates ■ Log in ■ Privacy Policy, Disclaimer, Visitors count, Important links, Site map
3	Branding: Communicates a sense of 'identity at first glance
4	Visual appeal: The site must have an attractive mix of text, images, audio, and video
5	Fast Loading Pages: Optimization of web pages for a faster browsing experience with compatibility with key industry browsers and platforms
6	Responsive Design: The site must be mobile optimized through responsive design methods. Therefore, it should detect that a mobile device is being used and present the user with the mobile version first. The user should be able to switch to the desktop version and adjust the resolution and format accordingly.
7	Bilingual: The portal shall be available in Tamil & English and Unicode complaints.
8	Simple and clear navigation: The site should be easy to navigate. Information should be grouped and presented logically and require no more than three levels of "drill down" for the user to find the desired information thus creating a clean, clear, easy, and satisfying user experience. This should include drop-down menus so that the visitor can easily find what they are looking for with a few clicks of the mouse.
9	Search Tools: Provide search capabilities using keywords or phrasing that will provide access to content from throughout the site. Additionally, make it possible to download historical and recent data whereby the user can define his/her preference. The platform should allow users to search the content of the portal easily and quickly without the need for high-speed bandwidth.
10	Important Links: Links should be placed within the portal to allow individuals to contact institutions affiliated with the CSCL/CITS and access to the portal as well the respective departments/agencies/Commuters/City User.
11	Easy access to Key performance indicators (Infographics): Seamless presentation of dashboard data to provide continuously updated graphs and charts.
12	News/Update feed: Constant and dynamic update feed on the portal home page. Displays announcements and notifications for new content additions on the front page of the portal.
13	Calendar and bookings:

	A dynamic calendar that displays events as well as filters for searching events going to be in the city and impact on traffic.
14	Contact Form: Provides a web-based contact form with anti-spam controls and shall allow stakeholders to track the status of the request at any point of time if any.
15	e-Mails: Automatically send follow-up emails to our stakeholders (subscribers) if they visited a specific web page, or completed some specific task (e.g., survey) on the website.
16	Search Engine Optimization (SEO): Portal availability using common search engines to ensure it is optimized using SEO.
17	Search capability: Portal should provide a search engine with advanced full-text search capabilities.
18	Compatibility: The site must be compatible with common operating platforms including Google Chrome, Microsoft Edge, Mozilla Firefox, and Safari 5.0 or higher.
19	Mobile Access: Portal must be “responsively designed” to accommodate mobile users. This also includes accommodations for slower, cellular internet connections. This includes compatibility with iOS, Android, and other industry-standard platforms
20	Settings: Portal must not require plug-ins as a default.
21	Performance: Portal must be able to handle multimedia (video) with high performance.
22	HTML Compliance: Full compliance with HTML 5.0 or higher.
23	GIS: web GIS view of CSCL/CITS depicting information through various layers would be shown to stakeholders, showing occupied and vacant land parcels, access to information on industries, residential, education & health facilities, Traffic Junction, ITS- Equipment, Traffic Movement, transportation, etc.
24	■ Security: Portal shall be secure against hacking and other vulnerable activities
25	Content Management System: <ul style="list-style-type: none"> ■ shall have Content Management System to update the content on the Portal which shall have minimum following capabilities: <ul style="list-style-type: none"> ✓ Content Authoring ✓ Content Publishing ✓ Content Delivery ✓ Content Storage Management ✓ Content Archival ■ Separation of content from presentation, which allows authors to focus on content rather than web design. ■ Content storage management of all types of content; text graphic, audio, video, etc.
26	Integration with other applications: Different existing and applications/modules shall have to be seamlessly integrated with the portal. It is envisaged that GIS and the proposed systems shall work in an integrated manner to allow CSCL/CITS to extract maximum benefits from the system.

27	<p>Design and Construction</p> <ul style="list-style-type: none"> ■ Work closely with the CSCL/CITS at each stage of the design to identify user needs and corresponding user interface requirements, workflows, and functionalities ■ Ensure integration of all elements including content, information format, compatibility with software platforms used by CSCL/CITS, and standards for content management Platform should allow easy integration of multimedia products and user- friendly administrator interface ■ Create wireframes, storyboards, and prototypes to propose options for implementation. Provide five (5) template designs for review to select a concept ■ Concepts should reflect the CITS/CSCL identity, nature, and purpose ■ Develop corresponding user interface components (web templates, style sheets, scripts, Images, dashboards, social media interfaces) as needed ■ Use simple, cost-effective techniques to test designs with representatives of the target audience before the launch of the portal ■ Submit the final concept to CSCL/CTP for review before ‘going live ■ Keep a full backup of the portal through the Project ■ Manage all upgrades and updates on the website including a content update in an efficient and integrated manner ■ The portal design shall support easy upgrades and updates on content without the need to redo the base design.
Mobile App	
28	<ul style="list-style-type: none"> ■ With rapidly increasing levels of mobile penetration and continuous improvement in bandwidth, and requirements of accessibility and citizen convenience, it has been envisaged to offer information dissemination to stakeholders over mobile devices. There shall be a strong interface, technologies, applications, etc. for mobile devices. ■ To maximize citizen convenience and bring about business process, improvements, the successful MSI shall continuously innovate, upgrade and incorporate such new technologies that emerge new avenues. ■ Mobile app should mirror the portal and be adapted for optimum viewing on multiple operating systems and device sizes. However, the actual application layout design for both mobile and web is the responsibility of the Contractor ■ The mobile app must be based on the latest HTML 5 and above. ■ The mobile app shall be native on Android and iOS, platforms. ■ The mobile app should be in Tamil & English. ■ Mobile app should be capable of showcasing enriched infographics to their stakeholders. ■ The mobile app shall be designed in such a manner that it shall address the following key issues: <ul style="list-style-type: none"> √ Caching: Caching unnecessary data on a device that has limited resources. √ Communication: Failing to protect sensitive data over any carrier. √ Data Access: Failing to implement data access mechanisms that work with intermittent connectivity ■ The mobile app shall be integrated with the main core solution proposed. There shall be a facility to PUSH through and PULL through the mechanism to get and receive information using SMS service. ■ The mobile app shall provide critical data such as user identification and location information including latitude, longitude.. ■ The mobile app shall have the ability to take and transmit, pictures and videos in real-time along with geo-tags from the device. ■ Mobile app should have the capability of - <ul style="list-style-type: none"> √ Image compression, B/w conversion from color images

	<ul style="list-style-type: none">√ Auto cropping, Auto orientation, perspective correction, geo capture√ Image capture setting (camera resolution, image type)■ The mobile app shall have the ability to push information to the mobile app as well as post bulletins and resources on the mobile app through API's.■ The platform will provide a report generating tool, which can be used to generate customized reports at any level■ The platform should allow for a graphical interface to view the summary data in MIS reports. This would include trend graphs, graphs indicating how much of the target has been met, etc.■ Mobile App shall be able to take input information probe system■ Mobile App shall be show traffic information as well as take information from the city bus system■ Commuter/CTP shall have the option to update incident/accident/information for traffic with snap and video
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5 Installation Requirement

The Contractor shall consider the following factors while implementing ITMS module in TIMS-CCC. Necessary approvals will be taken by the Contractor before implementation.

- Conduct installation of the equipment with prudent consideration to earthquake-resistance.
 - A space should be secured behind Video Wall for heat releasing and maintenance work.
 - All cables should be installed with proper cable wiring arrangement structure in order not to disturb the flow line of users.
-

Chapter 2-3 Requirements of Adaptive Traffic Signal Control System

1 General

One of the primary objectives of this project are to improve congestion management and traffic safety in the city through application of intelligent transportation options involving traffic signaling, traffic management, congestion monitoring, mass transport improvement and information dissemination.

Traffic signals, when implemented properly, provide smooth movement of traffic by separating out conflicting movements in time (temporal separation). The purposes of the Adaptive Traffic Signal Control System (ATCS) for the Project are:

- (a) Improve travel time reliability
- (b) Automatically adapt to fluctuating traffic conditions
- (c) Improve safety and reduce congestion and fuel consumption
- (d) Make signals less dependent on continuous traffic police presence and monitoring
- (e) Enhance signal operations through the adaptive signal sensors and performance-based monitoring

2 System Configuration

ATCS comprises the roadside equipment and the central server application as shown below.

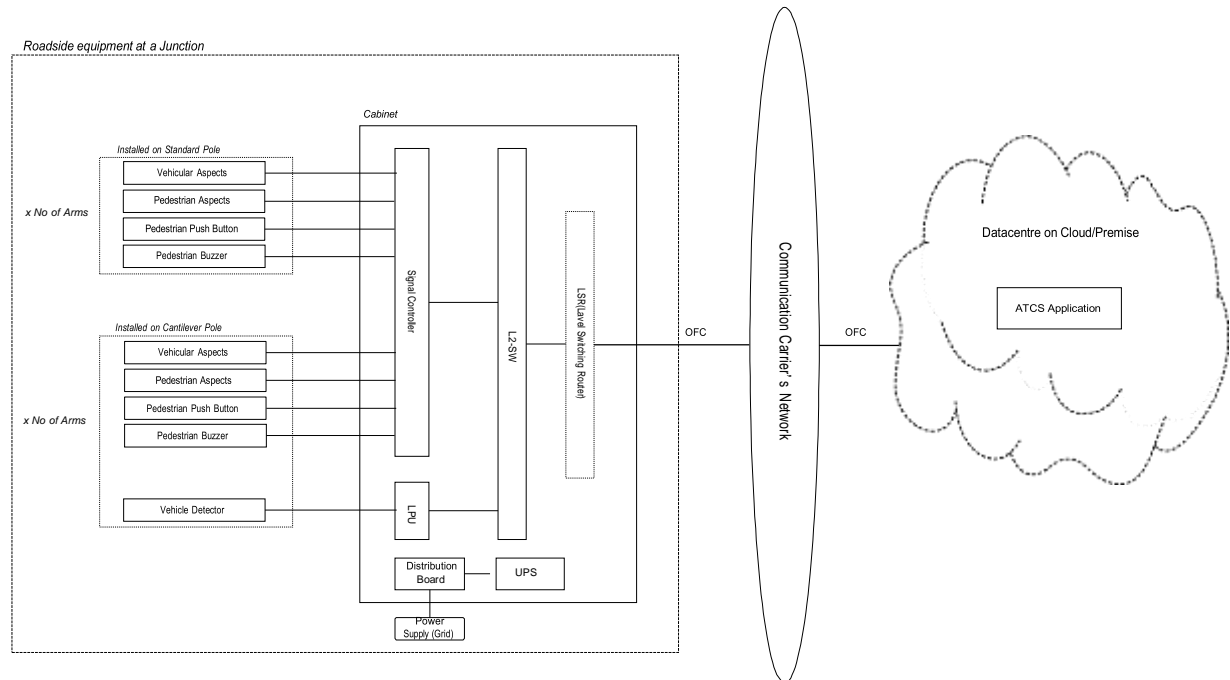


Figure 2-1: System Configuration of ATCS

3 Equipment Location

The locations of 165 intersections where the traffic signal is to be installed are as follows. The proposed locations for ATCS are shown below in the Table. The Contractor shall adhere to the proposed locations as much as possible to satisfy the above requirement. In case of any changes in the locations the Contractor shall get the written approval from the Engineer based on the alignment, geometry, viewing area (based on site visit).

Table 3-1: Target Location of ATCS

S No	Location Name	Latitude	Longitude	Corridors Name	Intersection Category
1	Anna Salai X Poes Road (Anna Arivalayam)	13.042401	80.247615	Mount Road (Anna Salai)	3 legged
2	Anna Salai X Sivasankaran Road	13.045196	80.247956	Mount Road (Anna Salai)	3 legged
3	Anna Salai X Kavignar Bharathidasan Road (SIET)	13.0357109	80.2460885	Mount Road (Anna Salai)	4 legged
4	Anna Salai X Eldams Road	13.039298	80.24696	Mount Road (Anna Salai)	4 legged
5	Anna Salai X Dams Road	13.066434	80.268391	Mount Road (Anna Salai)	3 legged
6	Anna Salai X General Patters Road	13.0657774	80.2676206	Mount Road (Anna Salai)	3 legged
7	Anna Salai X Blackers Road	13.068072	80.271206	Mount Road (Anna Salai)	3 legged
8	Anna Salai X Pallavan Salai	13.073775	80.276466	Mount Road (Anna Salai)	3 legged
9	Anna Salai X Wallajah Road (Anna Statue)	13.068475	80.27192	Mount Road (Anna Salai)	4 legged
10	Anna Salai X Swami Sivananda Salai (Periyar Statue)	13.071693	80.27441	Mount Road (Anna Salai)	4 legged
11	Anna Salai X Binny Road (Spencer Plaza)	13.062043	80.26305	Mount Road (Anna Salai)	4 legged
12	Anna Salai X Venkatanarayana Road (Nandhanam)	13.031025	80.239778	Mount Road (Anna Salai)	4 legged
13	Anna Salai X Todd Hunter Road	13.024664	80.228972	Mount Road (Anna Salai)	4 legged
14	Anna Salai X CIT Nagar 1st Main Road	13.026049	80.231375	Mount Road (Anna Salai)	4 legged
15	Anna Salai X CIT Nagar 3rd Main Road	13.02665	80.233045	Mount Road (Anna Salai)	3 legged
16	Anna Salai X Lampart Church (Aruna Pedestrian)	13.01525	80.22473	Mount Road (Anna Salai)	2 legged
17	Anna Salai X Sardar Patel Road	13.0121346	80.2213174	Mount Road (Anna Salai)	3 legged
18	Anna Salai X Saidapet Metro Station	13.0244088	80.2285828	Mount Road (Anna Salai)	2 legged
19	Anna Salai X Flag Staff Road	13.0789169	80.2819581	Mount Road (Anna Salai)	3 legged
20	Anna Salai x Velachery Main Road	13.0154738	80.2253321	Mount Road (Anna Salai)	4 legged

S No	Location Name	Latitude	Longitude	Corridors Name	Intersection Category
21	Anna Salai X Jeenis Road	13.0199885	80.2246286	Mount Road (Anna Salai)	3 legged
22	Anna Salai X Smith Road (Ty.Switched Off- CMRL work)	13.0599413	80.2604082	Mount Road (Anna Salai)	4 legged
23	Anna Salai X Whites Road(Ty.Switched Off- CMRL Work)	13.056485	80.256679	Mount Road (Anna Salai)	3 legged
24	Anna Salai X Thiru. Vee Ka Salai	13.0576172	80.2576985	Mount Road (Anna Salai)	2 legged
25	Anna Salai X Cenatoph Road	13.034666	80.245666	Mount Road (Anna Salai)	3 legged
26	EVR Salai X Ritherdon Road	13.079377	80.258767	EVR Salai	3 legged
27	EVR Salai X EVK Sampath Road	13.080241	80.262769	EVR Salai	4 legged
28	EVR Salai X Gandhi Irvin Bridge Road	13.080685	80.265141	EVR Salai	3 legged
29	EVR Salai X Dr. Nair Road	13.079049	80.256685	EVR Salai	4 legged
30	EVR Salai X Raja Annamalai Road	13.078976	80.254701	EVR Salai	4 legged
31	EVR Salai X Raja Muthiah Road	13.0809508	80.2709004	EVR Salai	3 legged
32	EVR Salai X Burnaby Road	13.077876	80.244459	EVR Salai	3 legged
33	EVR Salai X Gengu Reddy Road	13.078834	80.251715	EVR Salai	3 legged
34	EVR Salai X Taylors Road	13.076659	80.238106	EVR Salai	3 legged
35	EVR Salai X Dr. Guruswamy Bridge	13.077246	80.240727	EVR Salai	4 legged
36	EVR Salai X Nelson Manickam Road	13.074357	80.220917	EVR Salai	3 legged
37	EVR Salai X Anna Arch Road	13.074933	80.217904	EVR Salai	4 legged
38	EVR Salai X Pulla Avenue	13.074027	80.224776	EVR Salai	3 legged
39	EVR Salai X Lakshmi Talkies Road	13.0740185	80.2275227	EVR Salai	4 legged
40	EVR Salai X NSK Nagar Main Road	13.075125	80.2160633	EVR Salai	4 legged
41	EVR Salai X Pallavan Salai (Central Railway Station)	13.08168	80.275147	EVR Salai	3 legged
42	EVR Salai X Evening Bazzar Road	13.082172	80.27847	EVR Salai	3 legged
43	EVR Salai X 8th Main Road (Naduvankarai)	13.076985	80.211716	EVR Salai	3 legged
44	EVR Salai X Muthuswamy Road	13.082268	80.281517	EVR Salai	3 legged
45	EVR Salai X New Avadi Road (Pachiyappas)	13.075805	80.233878	EVR Salai	3 legged

S No	Location Name	Latitude	Longitude	Corridors Name	Intersection Category
46	EVR Salai X Harrington Road	13.075297	80.232028	EVR Salai	3 legged
47	Inner Ring Road X Periyar Pathai	13.0587571	80.2115146	Inner Ring Road	3 legged
48	Inner Ring Road X Nerkundram Pathai	13.054501	80.211364	Inner Ring Road	4 Legged
49	Inner Ring Road X Ashok Nagar 4th Avenue	13.037288	80.21234	Inner Ring Road	3 legged
50	Inner Ring Road X Ashok Pillar	13.034817	80.212094	Inner Ring Road	4 Legged
51	Inner Ring Road X Vinayagapuram Main Road	13.063784	80.211639	Inner Ring Road	4 Legged
52	Inner Ring Road X CMBT	13.0699119	80.2049554	Inner Ring Road	3 legged
53	Inner Ring Road X Annai Sathya Nagar (Games Village)	13.067498	80.208623	Inner Ring Road	3 legged
54	Inner Ring Road X Arcot Road (Vadapalani Signal)	13.049875	80.211974	Inner Ring Road	4 Legged
55	Inner Ring Road X PT Rajan Road(Laxman Suruthi)	13.044291	80.212276	Inner Ring Road	4 Legged
56	Inner Ring Road X CMBT Emergency Exit	13.069278	80.205872	Inner Ring Road	3 legged
57	Inner Ring Road X Poonamalee Road	13.021752	80.20642	Inner Ring Road	4 Legged
58	Inner Ring Road X Water Works Road (Cipet)	13.0137561	80.2042721	Inner Ring Road	4 Legged
59	Inner Ring Road x Kalaimagal Nagar	13.0241386	80.2067246	Inner Ring Road	4 Legged
60	Inner Ring Road X MH Point	13.0015184	80.1959495	Inner Ring Road	3 legged
61	Inner Ring Road X Jafferkhanpet Main Road(Kasi Theatre)	13.0302175	80.2090622	Inner Ring Road	4 legged
62	Inner Ring Road X 18th Main Road	13.094848	80.198605	Inner Ring Road	3 legged
63	Inner Ring Road X Anna Nagar 2nd Avenue	13.085394	80.198527	Inner Ring Road	4 legged
64	Inner Ring Road X Kalamman Koil Street (Ty. Switched off)	13.072079	80.202083	Inner Ring Road	4 legged
65	Inner Ring Road X Ambal Nagar Main Road	13.01777	80.205775	Inner Ring Road	4 Legged
66	Inner Ring Road X Ambattur Estate Rd	13.087186	80.1984573	Inner Ring Road	4 legged
67	Kamarajar Salai X Dr.Besant Road	13.050506	80.280535	Kamarajar Salai	3 legged
68	Kamarajar Salai X Dr. Radhakrishnan Salai	13.043386	80.279739	Kamarajar Salai	3 legged
69	Kamarajar Salai X Wallahjah Road	13.064171	80.283466	Kamarajar Salai	3 legged

S No	Location Name	Latitude	Longitude	Corridors Name	Intersection Category
70	Kamarajar Salai X Karaneeswarar Koil Street	13.0373745	80.2782788	Kamarajar Salai	4 legged
71	Kamarajar Salai X Pycrofts Road	13.057523	80.2820111	Kamarajar Salai	3 legged
72	Kamarajar Salai X Swami Sivananda Salai	13.0680076	80.2842271	Kamarajar Salai	3 legged
73	Kamarajar Salai X Foreshore Estate Promenade(near marina beach police station)	13.0394222	80.2789943	Kamarajar Salai	3 legged
74	GST Road X Airport Service Road (Palavanthangal)	12.994032	80.185457	GST Road	3 legged
75	GST Road X Air Port Entrance	12.981726	80.166908	GST Road	3 legged
76	GST Road X Airport Service Road (Old Airport Junction)	12.98978763	80.1792152 4	GST Road	4 legged
77	GST Road X MKN Road	12.996131	80.1892435	GST Road	3 legged
78	GST Road X Kamarajar Street (Meenambakkam Bazaar)	12.9864533	80.1747667	GST Road	3 legged
79	GST Road X Air Port exit gate	12.97989844	80.1629319 7	GST Road	3 legged
80	LB Road X Indira Nagar 1st Avenue	12.999493	80.256132	LB Road	4 legged
81	LB Road X Sardar Patel Road	13.006703	80.257619	LB Road	4 legged
82	LB Road X Mahatma Gandhi Road	12.996921	80.255828	LB Road	4 legged
83	LB Road X Kamarajar Avenue 2nd Street	13.0012347	80.2565783	LB Road	4 legged
84	LB Road X Kalashetra Road	12.990393	80.256044	LB Road	4 legged
85	LB Road X East Coast Road (Thiruvannmiyur)	12.987682	80.255948	LB Road	4 legged
86	Sardar Patel Road X Rajiv Gandhi Salai (Madya Kailas)	13.006641	80.247484	Sardar Patel Road	4 legged
87	Sardar Patel Road X Gandhi Mandapam Road	13.006796	80.240319	Sardar Patel Road	3 legged
88	Sardar Patel Road X Kasthuribai Nagar Road	13.006705	80.251709	Sardar Patel Road	3 legged
89	Sardar Patel Road X Velachery Main Road(Concord)	13.011354	80.223249	Sardar Patel Road	4 legged
90	Sardar Patel Road X Vinayagar Koil Street (Servant Gate)	13.010694	80.224873	Sardar Patel Road	5 legged
91	Sardar Patel Road X Anna University	13.007906	80.234976	Sardar Patel Road	3 legged
92	South Usman Road X New Boag Road	13.030739	80.230729	Usman Road	4 legged

S No	Location Name	Latitude	Longitude	Corridors Name	Intersection Category
93	South Usman Road X Burkit Road	13.035013	80.230259	Usman Road	4 legged
94	North Usman Road X Bazullah Road	13.04744	80.23307	Usman Road	4 legged
95	CIT Nagar 1st Main Road X North Road	13.029541	80.230797	Usman Road	3 legged
96	South Usman Road X Mannar Street	13.0341745	80.2304081	Usman Road	4 legged
97	RK Salai X Dr.Natesan Road	13.04346	80.274272	Dr Radha Krishnan Road	4 legged
98	RK Salai X Sivasamy salai (Nilgris Jn)	13.044609	80.263538	Dr Radha Krishnan Road	4 legged
99	RK Salai X Royapettah High Road	13.044582	80.266882	Dr Radha Krishnan Road	4 legged
100	RK Salai X TTK Salai	13.045397	80.259873	Dr Radha Krishnan Road	4 legged
101	RK Salai X Light House Station Road	13.0433692	80.2764331	Dr Radha Krishnan Road	3 legged
102	Rajaji Salai X Flag Staff Road	13.07391	80.285673	Rajaji Salai	4 legged
103	Rajaji Salai X Secretariate out gate	13.08005838	80.28804833	Rajaji Salai	3 legged
104	Rajaji Salai X Jaffar Sarang Street	13.095145	80.292515	Rajaji Salai	3 legged
105	Rajaji Salai X NSC Bose Road (Parrys Corner)	13.088819	80.29044	Rajaji Salai	3 legged
106	Cathedral Road X Muthiah Mudali Street	13.04871786	80.25354054	Cathedral Road	3 legged
107	Cathedral Road X Anna Salai	13.052325	80.251009	Cathedral Road	4 legged
108	Cathedral Road X Binny Road	13.0466962	80.254842	Cathedral Road	3 legged
109	Cathedral Road X Kasthuri Rangan Road	13.0460285	80.2567292	Cathedral Road	4 legged
110	Arcot Road X Puliyur Main Road (Gogulam Point)	13.0534171	80.2241657	Arcot Road	3 legged
111	Arcot Road X Dr. Ambedkar Road	13.052399	80.220397	Arcot Road	4 legged
112	Arcot Road X Duraiswamy Road	13.0505178	80.2146754	Arcot Road	3 legged
113	Arcot Road X Mahalingapuram Main Road	13.053783	80.234625	Arcot Road	4 legged
114	Kodambakkam High Road X Uthamar Gandhi Salai	13.05373916	80.25028515	Kodambakkam High Road	3 legged
115	Kodambakkam High Road X Valluvar Kottam High Road	13.052622	80.241718	Kodambakkam High Road	3 legged
116	Kodambakkam High Road X Josier Street	13.052863	80.245455	Kodambakkam High Road	4 legged

S No	Location Name	Latitude	Longitude	Corridors Name	Intersection Category
117	Kodambakkam High Rd X Vidyodaya Main Road	13.0527964	80.2431093	Kodambakkam High Road	4 legged
118	Nelson Manickam Road X 2nd Main Road	13.069766	80.224539	Nelson Manickam Road	4 legged
119	Nelson Manickam Road X Choolaimedu High Road	13.0665761	80.2313653	Nelson Manickam Road	4 legged
120	Nelson Manickam Road X Sterling Road	13.063974	80.235229	Nelson Manickam Road	4 legged
121	Nelson Manickam Road X Metha Nagar Main Road (Switched Off)	13.068071	80.226494	Nelson Manickam Road	3 legged
122	G N Chetty Road X Dr. Nair Road	13.0451	80.24026	GN Chetty Road	4 legged
123	G N Chetty Road X Srinivasa Road	13.042684	80.23588	GN Chetty Road	4 legged
124	GN Chetty Road X North Boag Road (Barathyraja Hospital) (Ty.Switched off - CMRL work)	13.047797	80.245195	GN Chetty Road	4 legged
125	Indira Nagar 2nd Avenue X 1st Avenue (WaterTank)	12.995068	80.252379	OMR	4 legged
126	Rajiv Gandhi Salai X Indira Nagar 2nd Avenue	12.994414	80.249729	OMR	3 legged
127	Rajiv Gandhi Salai X East Coast Road	12.9875624	80.2516636	OMR	3 legged
128	Greenways Road X MRC Nagar Main Road	13.02079	80.26969	Greenways Road	4 legged
129	Greenways Road X R A Puram 2nd Main Road	13.027225	80.253791	Greenways Road	4 legged
130	Greenways Road X Durgabai Deshmukh Road	13.0186045	80.2612478	Greenways Road	4 legged
131	Ramakrishna Mutt Road X S Canal Bank Road (Mandaveli Jn)	13.026251	80.265936	Ramakrishna Mutt Road	4 legged
132	Ramakrishna Mutt Road X Venkatesa Agraharam Road	13.032639	80.2675142	Ramakrishna Mutt Road	4 legged
133	Luz Church Road X Royapettah High Road	13.036918	80.267533	Ramakrishna Mutt Road	4 legged
134	Mowbrays Road X Pasumpon Muthuramalinga Thevar Road	13.0288459	80.2497281	Mowbrays Road (TTK Road)	4 legged
135	Mowbrays Road X Musiri Subramaniam Road	13.03887352	80.2572822	Mowbrays Road (TTK Road)	4 legged
136	Mowbrays Road X Eldams Road	13.0380699	80.2565764	Mowbrays Road (TTK Road)	4 legged

S No	Location Name	Latitude	Longitude	Corridors Name	Intersection Category
137	Valluvarkottam High Road X Harrington Road (Chetpet)	13.069278	80.242266	Valluvarkottam High Road	4 legged
138	Valluvarkottam High Road X Tank Bund Road	13.05685387	80.24265372	Valluvarkottam High Road	5 legged
139	Valluvarkottam High Road X Sterling Road	13.0659432	80.2435093	Valluvarkottam High Road	4 legged
140	C P R Road X 2nd Main Road (Kaliyappa Hospital)	13.027116	80.256546	Pasumpon Muthuramalingam Salai	4 legged
141	C P R Road X Rangacharry Road	13.033335	80.256917	CP Ramaswamy Iyer Road	4 legged
142	C P R Road X St Marrys Road	13.028861	80.256456	CP Ramaswamy Iyer Road	4 legged
143	DD Road X Gandhi Nagar 4th Main Road	13.009366	80.259115	DurgaBai Deshmukh Road	3 legged
144	DD Road X Dr MGR janaki college of arts and science	13.0161316	80.2595348	DurgaBai Deshmukh Road	2 legged
145	Evening Bazaar Road X Rattan Bazaar Road (MUC)	13.085847	80.280831	Evening Bazaar Road	4 legged
146	Gandhi Mandapam Road X Ponniamman Koil Street	13.018096	80.241133	Gandhi Mandapam Road	4 legged
147	Gandhi Mandappam Road X Murugappa Road	13.0195224	80.2415144	Gandhi Mandapam Road	3 legged
148	Walltax Road X Elephant Gate Street	13.092325	80.275231	Grand Northern Trunk Road	4 legged
149	Walltax Road x Rasappa Chetty Street	13.086618	80.275773	Grand Northern Trunk Road	3 legged
150	Muthuswamy Road X Esplanade Road	13.085379	80.284212	Muthuswamy Road	3 legged
151	Ethiraj Salai X Rukmani Lakshmipathi Road	13.0639004	80.2600073	Ethiraj Salai	3 legged
152	NSC Bose Road X Broadway Road	13.088445	80.285312	NSC Bose Road	4 legged
153	Pasumpon Muthuramalingam Salai X Cenotaph Road	13.0295244	80.2457852	Pasumpon Muthuramalingam Salai	4 legged
154	Royapettah High Road X Peters Road	13.053899	80.264041	Royapettah High Road	4 legged
155	Santhome High Road X Rosary Church Road	13.033444	80.277338	Santhome High Road	4 legged
156	Santhome High Road X South Canal Bank Road	13.023979	80.273812	Santhome High Road	4 legged
157	Sir Theagaraya Road X North Boag Road (Ma.Po.Ce)	13.039875	80.244021	Sir Theagaraya Road	4 legged
158	Taluk Office Road X Lourd Doss Grotto Road (MTC Depot)	13.014482	80.2261651	Taluk Office Road	3 legged

S No	Location Name	Latitude	Longitude	Corridors Name	Intersection Category
159	Tank Bund Road X Mahalingapuram Main Road	13.0610903	80.2375115	Tank Bund Road	4 legged
160	Tank Bund Road X Sterling Road(near Loyola College)	13.0627278	80.2360488	Tank Bund Road	3 legged
161	Uthamar Gandhi Road X Haddows Road	13.06131	80.24698	Uthamar Gandhi Road	3 legged
162	Venkatanarayana Road X Burkit Road	13.034389	80.237615	Venkatanarayana Road	4 legged
163	Venkatanarayana Road X Sivagnanam Street	13.039157	80.234583	Venkatanarayana Road	5 legged
164	Wallahjah Road X Quaid-E-Millath Road	13.066758	80.273774	Wallahjah Road	3 legged
165	Wallahjah Road X Bells Road	13.064713	80.278343	Wallahjah Road	3 legged

4 System Functional Requirements

4.1 Functional Requirements of ATCS Application

The system functional requirements of the ATCS application are shown in the table below.

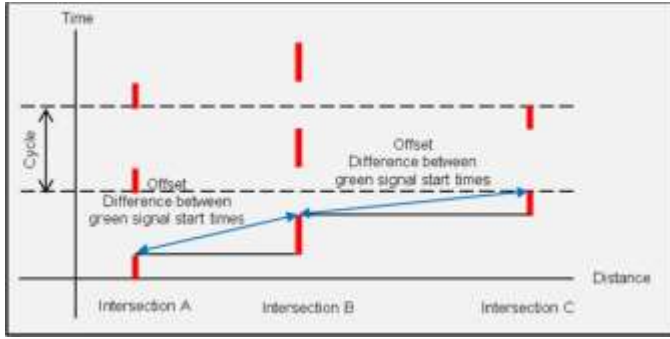
Table 4-1: System Functional Requirements of ATCS Application

No.	Requirements
General	
1.	The system shall adaptively control a minimum of 165 traffic signals concurrently, expandable to 1000 traffic signals in the future.
Signal Control Function	
1.	■ ATCS should be able to optimize the signalized intersection cycle length, offset and splits.
2.	■ ATCS should be able to calculate in real time the optimal cycle times, effective green time ratios, and change intervals for all system traffic signal controllers. Such calculations will consist of simulations carried out in the central control computer, or individual traffic signal controller, based on a data and information transmitted by the vehicle detectors at the intersections controlled by the system.
3.	■ ATCS shall have an ability to set signal timing parameters for each individual stage/phase (such as yellow/amber time, all-red time, minimum green, maximum green, pedestrian walk & flashing don't walk time, and extension time) separately.
4.	■ The variation if appropriate of green transitions and change intervals within ATCS shall occur at least once every traffic signal cycle, while the adjustment of cycle time will occur, at least, once every two and half minutes.
5.	■ ATCS shall be capable of producing minor and frequent changes of the traffic control parameters, smoothly becoming suitable for the traffic variations without disrupting the flow. Systems based on vehicle actuation, whereby the green phase times are determined according to the number of "extensions" given by the vehicle detectors will qualify as real time control systems provided that they do not only optimize the traffic at each intersection locally, and in isolation from the rest of the system.
6.	■ The values for at least two of the parameters (green splits, offsets, and cycle times) be computed in real time by the central computer, based on traffic levels at each instant in time (milliseconds). With the exception of the initial values (system start-up), it shall not be necessary to furnish the system any value for the said parameters.

7.	■ It shall be possible to divide the area under control into a minimum of 100 fully adaptive regions. It shall be possible to impose any operator command on all the intersections within a
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	region, sub-area or group by a single operator instruction.
8.	<ul style="list-style-type: none"> As frequently as the system workload allows automatic checks shall be carried out on as much of the system as possible. Where incorrect operation is detected a system alarm and suitable message shall be given.
9.	<ul style="list-style-type: none"> ATCS shall permit any combination of the following degrees of adaptive control optimization by operation from the Control center workstations. <ul style="list-style-type: none"> ✓ Split optimization on/off (node basis) ✓ Offset optimization on/off (node basis) ✓ Cycle time optimization on/off (region basis) ✓ Limitation of the minimum permitted cycle time (region basis) ✓ Limitation of the maximum permitted cycle time (region basis) ✓ Set single/double cycling restraint (to prevent the system from double cycling nodes within the overall region cycle time, node basis).
10.	<ul style="list-style-type: none"> Under all control modes except the failure modes resulting from the complete loss of communication between the computer system and any outstation modem (at any traffic signal controller), all reply messages shall be analyzed within the central computer system to detect the presence of faults.
(1) Fully Adaptive Traffic Control (FATC)	
1.	<ul style="list-style-type: none"> ATCS shall be able to initially set adaptive regions (subareas) which comprises from 1 up to 20 signalized junctions. The distance between adjacent intersections for organizing an adaptive region shall be less than around 400 m. ATCS shall be able to maximize the traffic efficiency (minimize the delay time) in the adaptive region, calculating the signal cycle based the real-time traffic conditions in such adaptive region. ATCS shall be able to enable the automatic subarea formulation which is to dynamically connect and separate adjacent adaptive regions(subareas) comparing the real-time traffic conditions of each adaptive region to optimize the traffic flow. (for example: if difference of cycle length of each adaptive region(subarea) is less than 20 seconds, the adjacent adaptive regions(subareas) can be connected.) The Bidder shall propose the method to achieve the automatic subarea formulation and fully adaptive traffic control.
2.	<ul style="list-style-type: none"> Implementing a new fully adaptive strategy plan shall be performed without loss of control at any node or introducing abnormal on-street timings. In the event of a fully adaptive detector becoming faulty, it shall be possible for default splits to be used for the relevant stage, whilst the remainder of the stages at that node maintain fully adaptive operation.
(2) Pattern Selection Control	
1.	<ul style="list-style-type: none"> Pattern Selection Control shall be able to select pre-set patterns for the control parameters in accordance with traffic conditions detected by the controller. This mode is performed as a backup when the full adaptive traffic control is not available due to the equipment failure or the communication interruption etc.
2.	<ul style="list-style-type: none"> ATCS shall be able to create pre-set offset patterns and set them in the designated line.
(3) Time of Day Control Function	
1.	<ul style="list-style-type: none"> This is the control mode based on the time-of-day table (signal phase plan corresponding to the hour and day of the week) stored in the controller. This mode is performed as a backup when the pattern selection control is not available due to the failure of vehicle detector etc. The system shall be able to create the time-of-day table based on the collected traffic data. The time-of-day table stored in the controller shall be updated at least once a week. A fully adjustable and flexible timetable facility shall be available within both the fully adaptive and fixed time modes of control & shall consist of: <ul style="list-style-type: none"> ✓ a minimum of 10 different Time of Day schedules each covering a 24-hour period, and starting at midnight; ✓ definition of abnormal days within the next year when a particular Time of Day Schedule is required for reasons such as a public holiday or a planned event; and ✓ a single Day of Week Schedule Monday through to Sunday which defines the Time of Day Schedules required each normal day of the week. Each Time of Day Schedule shall contain a minimum of 500 timetable events and an

	<p>alphanumeric description. A single 'event' shall be taken to be a real time fully adaptive or fixed time command applied either to a single node or a group of nodes or an entire fully adaptive region or Sub-area.</p> <ul style="list-style-type: none"> ■ Timetables shall be user-configurable by a "WINDOWS" interactive process. The timetable data shall be capable of being edited or modified on-line.
(4) Coordination Control Function	
1.	<p>ATCS shall provide an adaptive green wave:</p> <ul style="list-style-type: none"> ■ Provide adequate capacity to meet demand ■ Provide progression along coordinated routes to maximize the throughput during peak periods ■ Provide progression along coordinated routes to smooth the flow of traffic in one or both directions ■ Distribute phase times between movements to minimize the travel time delay
2.	<ul style="list-style-type: none"> ■ The System shall provide a minimum of 100 Green Wave routes with a maximum of 25 junctions on each Green Wave route. The system shall be capable of running a minimum of 15 Green Wave routes simultaneously in different regions without impeding the operation, response time and speed of implementation of any Green Wave which may already in operation. The maximum number of green wave routes that can be run in any region at any given time shall be restricted by the number of conflicts these produce. ■ The maximum time from the receipt at the System of a request for a Green Wave to initial transmission of data to implement the Green Wave shall not exceed 3 seconds. ■ Each Green Wave route shall define all junctions on the route. For each junction, there shall be: <ul style="list-style-type: none"> ✓ clearance stage to run prior to the main Green Wave stage/phase; ✓ time delay before the implementation of a stage/phase; ✓ time for duration of the Green Wave stage; ✓ an optional clearance stage/phase to be run before the junction reverts to normal operation. ■ A recovery plan, to run after the green wave, shall also be available. ■ These Green Wave route timings and the durations of their associated stage/phase offsets shall be user configurable. ■ Controllers on a Green Wave route shall continue to operate on their System or operator-imposed timings until the priority Green Wave stage/Milestone is required. When the required hold period for a controller has timed out, the previous form of control will resume automatically. In the case of controllers in fixed time operation, the cycle time counter shall be synchronized as if the Green Wave had not occurred. ■ The system shall allow the early termination of a Green Wave by an Operator for an Operator imposed Green Wave. ■ When a Green Wave is active, the plan compliance checking shall be inhibited on the appropriate controller and for a further 4 minutes after it has cleared. The System shall output a message on the operator terminal. ■ It shall be possible to enter new green wave data, modify existing green wave data or delete a green wave without taking the System off-line and output the data relating to any green wave to any Operator terminal.
(5) Intervention Control Function	
1.	<ul style="list-style-type: none"> ■ ATCS shall have ability to modify the sequence of phases to support the various operational strategies.
2.	<ul style="list-style-type: none"> ■ ATCS shall allow the operator to over-ride adaptive operation. The system shall create a log of all such interventions and changes in operations.
Priority of Traffic Control Function	
	<ul style="list-style-type: none"> ■ The application of the method of control shall be in accordance with the source of the request. These shall be applied according to the following priority list: <ol style="list-style-type: none"> ① Transit Signal Priority imposed by timetable or operator intervention; ② Diversion plan imposed either by operator command or timetable; ③ Fully adaptive control; ④ Patter Selection Control (Fixed time plan introduced by timetable)

	⑤ Time of Day Control
Data Accumulation Function	
1.	<ul style="list-style-type: none"> ■ ATCS shall be able to store all executed signal control parameters (cycle length and split) at designated intersection and system logs for a period of at least the past 3 years.
Displaying Function	
1.	<ul style="list-style-type: none"> ■ ATCS shall be able to display locations and status (Normal/Failure) of all roadside equipment such as Controllers, Communication Card/Modem, Power, Vehicle detectors, and signals on a map-based view.
2.	<ul style="list-style-type: none"> ■ ATCS shall be able to display all the executed signal control parameters (cycle length and split) at selected intersection by the operators.
3.	<ul style="list-style-type: none"> ■ ATCS shall be able to display the time space diagram (TSD) showing the actual lengths of the greens for the current plan timings such that they are monitored. The state of the selected stages/phases for each selected controller shall be represented by green, amber and red bars (corresponding to the stage/phases green, inter-green and stage red on street) and it shall be possible for the operator to superimpose diagonal lines representing selected traffic cruise speeds for both traffic directions over the display. ■ The system shall be able to display the coordination status when operators select the designated section.
	 <p>The diagram is a Time Space Diagram (TSD) with 'Time' on the vertical axis and 'Distance' on the horizontal axis. It shows three intersections: Intersection A, Intersection B, and Intersection C. Vertical red bars represent the signal states (green, amber, red) at each intersection. Horizontal dashed lines indicate the 'Cycle' length. Diagonal lines represent the 'Difference between green signal start times' and 'Offset' between intersections. The diagram illustrates the timing and coordination of traffic signals across multiple intersections.</p>
	Example of the Time Space Diagram
4.	<ul style="list-style-type: none"> ■ ATCS shall be able to graphically display the transition of subareas on a map-based view.
5.	<ul style="list-style-type: none"> ■ ATCS shall be able to display the list of the operational status including the detailed failure status of all equipment.
6.	<ul style="list-style-type: none"> ■ ATCS shall be able to display the list of the communication line status (Normal/Failure) and the detailed failure status. ■ The system shall be able to display the communication line status with appropriate colour coding on a map-based view.
7.	<ul style="list-style-type: none"> ■ ATCS shall be configured to operate within a GUI type of Operator terminal screen display environment.
8.	<ul style="list-style-type: none"> ■ It shall be possible to display a minimum of 8 active displays on each Operator terminal and every display shall be capable of showing in real time ATCS facilities and events.
9.	<ul style="list-style-type: none"> ■ It shall be possible for an operator to define and re-size all displays on all Operator terminals. It shall be possible for any user to position the displays anywhere on the screen or 'put them to one side' and yet remain active - i.e., not visible on the screen except for an icon reference symbol. Icon symbols for all 'put to one side displays shall occupy a minimal area of the screen.
11.	<ul style="list-style-type: none"> ■ ATCS shall have the facility to show System real-time information changes including 'user defined text' within the graphical displays. As a minimum requirement, the graphical displays shall be capable of providing the following: <ul style="list-style-type: none"> ✓ Whole network area; ✓ Sub-area; ✓ Group; ✓ Signal junction; ✓ Signalled pedestrian crossing; ✓ Fixed Time region;

	<ul style="list-style-type: none"> ✓ Fixed Time node; ✓ Fully adaptive region (Subarea); ✓ Fully adaptive node (Green wave route).
Manual Operation	
	<ul style="list-style-type: none"> ■ It shall be possible for the operator or the computer to introduce automatically and/or to cancel a manually requested plan at a predetermined time specified in the timetable or requested by an operator when the override is initiated. ■ When such a plan is still in operation at a time when a timetabled plan is to be carried out, a suitable message or prompt containing the manually varied junctions shall be output no earlier than 15 minutes and no later than 5 minutes before the plan change time. The command used to maintain manually implemented plan(s) shall be on any area/sub-area, group, or junction basis. ■ If a manually imposed plan change overrides timetabled events, suitable messages shall be output at each timetable point, the system will remain on the existing timings until manual intervention is cancelled. ■ A plan that has been introduced manually or has been varied can be set on-line to be implemented at a user-defined time and timed out at another user-defined time. ■ It shall be possible for all-manual plans or variations to be automatically cancelled by a timetable event or a single manual command. ■ The introduction and subsequent cancellation of all manually introduced or varied plans shall be recorded in the System log. ■ It shall be possible to modify the action times/green splits or cycle time parameter of a fixed time plan currently in operation such that the resulting cycle time is different to that specified in the original plan. A suitable warning message shall be displayed on the operator's terminal when the cycle time is different. ■ It shall be possible using a single command to offset a group of junctions/nodes currently operating a fixed time plan by a single value, either in a positive or negative direction.
Plan Creation and Modification	
	<ul style="list-style-type: none"> ■ It shall be possible, for an operator whilst the ATCS is in either fully adaptive or fixed time mode of operation, to enter new plan data or modify existing plan data without taking the System off-line and to output this data to any operator terminal.
Command Macros	
	<ul style="list-style-type: none"> ■ The System shall be capable of implementing command 'macros'. A macro is a group or sequence of commands that are actioned together by one command. The commands shall be actioned together and in the order that they appear in the macro. Macros shall also be capable of being used to achieve any other function that may otherwise require the operator to undertake a series of commands and or actions. ■ It shall be possible to initiate or cancel a macro using a single command containing the macro by the name of the macro or other associated parameters. The introduction of plans or actions introduced as required by a macro shall have a higher priority than any timetable request. ■ It shall be possible to insert any fully adaptive control command into a macro and a macro shall be implemented by timetable or by operator command, or by remote request. ■ It shall be possible to create a macro with the System on-line and without invoking a text editor. It shall be possible to list all Macros that have been created, to modify them through an appropriate edit facility confirming their validity with on screen help guides and solutions to assist an operator in identifying syntax or other errors. There shall be a comprehensive database of example macros.
Method of Operation	
	<ul style="list-style-type: none"> ■ The System shall enable a minimum of 8 users to use the System simultaneously. Access to the System shall be by username and password. The System shall provide for a minimum of 48 user passwords. The System shall provide for a level of access for each configured user account. ■ The time and date of every Operator terminal connection and disconnection to the System shall be recorded in the System log including the associated username. ■ It shall be possible to inhibit remote access to the System by time of day. The access times shall be user definable and can be associated with certain levels of access. Similarly, it shall be possible to limit the remote access to the System by user at defined times of day.

Operator Interface	
	<ul style="list-style-type: none"> ■ It shall be possible to access the System from any of the Operator terminals with in main & satellite (if any) control rooms. ■ It shall be possible for all the System terminals to be logged on and fully functioning simultaneously. ■ A suitable message shall be output to any terminal inhibited from logging on. ■ The System shall provide three formats for command entry: <ul style="list-style-type: none"> ✓ Direct commands using a keyboard, including user defined `quick keys'. ✓ Mouse control using `drop down menus'; and ✓ Mouse control via graphic display icons. ■ The format for direct commands shall be logical and easily understood mnemonics. The Contractor shall submit a summary list of the proposed command mnemonics. ■ Mouse control shall enable direct commands to be implemented by `drop down menus. Selection from the menu shall activate a dialogue box or window area with text prompts for any required System command. ■ A facility shall also be included to enable an operator to acknowledge and automatically silence the alarm from any active Operator terminal. Whenever an alarm condition is generated, the System shall output an appropriate message indicating the reason for the alarm and the System date and time. Alarm acknowledgement shall initiate a listing of all previously unacknowledged alarms and every alarm acknowledgement and cancellation shall be recorded in the System log.
Management Function	
1.	<ul style="list-style-type: none"> ■ Shall have the functionality to supervise and control the system using web-interface so that maintenance is carried out with much ease.
2.	<ul style="list-style-type: none"> ■ The system shall provide user management system that allows access and operational privileges to be assigned, monitored and controlled.
Transit Signal Priority	
1.	<ul style="list-style-type: none"> ■ The system through the signal controllers shall provide transit signal priority and have logging data that include time of event, duration, and frequency for each of these events.
2.	<ul style="list-style-type: none"> ■ The system should provide transit signal priority for emergency vehicles, buses, VIP vehicles etc. based on Centre to Centre (C2C) communication and user selection (individual intersections and corridors). ■ The ATCS application shall integrate with the CAD/AVL application and accept triggers for TSP. The TSP call shall then be relayed in real-time to the field controller. ■ The controller shall provide Transit signal priority under all modes of system control; these shall include (i) extension, (ii) curtailment, and (iii) recall of any signal phases/stages, which are deemed to assist bus and emergency vehicles. ■ GPS unit for both emergency vehicles and VIP vehicles is not included in the scope.

4.2 Functional Requirements of Controller

Table 4-2: Functional Requirement of Controller

No.	Requirements
Capacity	
1	<ul style="list-style-type: none"> ■ Shall facilitate to configure 24 Cycle Plans and the Amber Flashing / Red Flashing plan.
2	<ul style="list-style-type: none"> ■ It shall have different stage switching sequences in different cycle plans.
3	<ul style="list-style-type: none"> ■ The controller shall have the capability for a minimum of 32 cycle-switching per day in fixed mode of operation.
4	<ul style="list-style-type: none"> ■ A minimum of 24 vehicle detector inputs, via an integral detector rack and 16 buffered additional inputs for connection of external devices such as push buttons shall be available in the controller. All inputs shall be isolated either optically or by other means and provided with LED indication. All 16 inputs for external devices shall be wired to the field terminal blocks in the controller housing. ■ Simulation of inputs shall be provided. IT shall be possible to set an input to the ON (short-

	circuit), OFF (open-circuit) or NORMAL state. It shall also be possible to examine the status of any input.
Functional Requirements (Operational Facilities)	
5	<ul style="list-style-type: none"> ■ The controller shall provide the following modes of operation:- <ul style="list-style-type: none"> ✓ Hurry Call ✓ Manual ✓ Full Adaptive Traffic Control (FATC) mode ✓ Time of Day Control mode ✓ Cable-less Linking ✓ Vehicle Actuation. ✓ Night-Time Flashing ✓ Safety Operation ■ The Controller shall provide a configurable priority structure for the operating modes. This shall be in a hierarchy format with higher priority configured modes taking precedence over lower priority configured modes, as mentioned above ■ The controller shall enter Flash-Amber/Flash-Red mode if a fault is detected at any time which may cause unsafe operation on site. These may result from conflict monitoring, hardware failures or red lamps failing on an approach and in turn causing an entry to be made in the fault log. Any fault condition which, may cause unsafe operation on site and places a Fault entry in the controller Fault/Error Log will cause the controller to enter the Flash Amber mode. At an appropriate time of day the FATC mode may isolate the local control to enter flashing amber/flashing red signal sequences. This sequence is to provide flashing amber aspects to main road approaches whilst indicating flashing red aspects to side road approaches. This facility shall be programmable via timetables in the standard system operation facilities and shall remain in operation until reset by the system timetable facilities on the following morning. ■ Mode Priorities - The controller shall normally operate in the appropriate mode of control for any particular site at any particular time of the day. The FATC mode computer may direct the local controller to operate in either the FATC mode or to revert to its mode priority as appropriate. ■ Demands - The controller will accept demands for operating modes as follows:- <ul style="list-style-type: none"> ✓ An actuation at the designated controller input will demand the Hurry Call mode. ✓ Connecting a manual push-button will demand the Manual mode. ✓ The FATC mode computer may command the controller to operate in either the FATC mode or by default the controller's mode priority. ✓ The controller timetable may command the controller to operate in either the Cable-less linking mode or vehicle actuation mode. ✓ Local linking which may command the control to operate in a selected mode. ■ Timetable - The controller shall provide control of "Time of Day" functions. Standard Timetable Control Functions shall include but not be limited to:- <ul style="list-style-type: none"> ✓ Signal aspect timing ✓ Special Facility control output switching ✓ Selection of fallback mode ✓ Signal plan selection ■ Timetable Scheduling - The controller clock time shall be used to activate the timetable requests by time of day and day of week. Timetable events shall be scheduled within a day by the hour, minute and second from the real-time clock so that the resolution can be to the nearest 1 second within any day. ■ The time clock system provides the facilities necessary for the controller to be integrated into a Cableless link system or to allow the controller to be operated in a fallback mode of operating in a Fully Adaptive Control Scheme. The time clock may additionally be used to achieve time-controlled switch facilities such as alternative timings, stage structure or the control of secret signs. ■ Manual Switch- A Switch shall be provided to control lamp status and provide for manual sequencing of the signal displays. The switch shall be directly accessible from the controller requiring the opening of a panel or door.

	<ul style="list-style-type: none"> ■ Cable-less Linking – The full adaptive control mode shall be able to command the controller to operate in the Cableless linking mode as either the normal mode of operation, or as the fallback mode of operation when the controller is no longer able to operate in the full adaptive control mode. Demands for higher priority modes of operation shall cause the controller to operate in the higher priority mode. ■ Operation - In the Cable-less linking mode the controller shall operate in accordance with the plan data stored in the controller. For controllers not connected to the central ATCS application, the plan data shall be stored in site specific data FLASH memory or battery backed RAM. The battery shall be capable of supporting this data for at least 8 hours following power disruption.
Vehicle Actuated Mode of Operation	
6	<ul style="list-style-type: none"> ■ Demand Conditions - The full adaptive control mode shall be able to command the controller to operate in the vehicle actuation mode as either the normal mode of operation or as the fallback mode of operation when the controller is no longer able to operate in the FATC mode. ■ The controller shall provide for vehicle actuated operation & the Bidder shall describe in detail the vehicle actuated operation with particular emphasis on its effects and control over intersection timings. ■ When communication to the FATC mode is lost the controller shall revert to the fallback mode of operation after a user configurable time period. That is, the highest priority mode within the controller's configuration. Demands for higher priority modes of operation shall cause the controller to operate in the higher priority mode selected. ■ Stage/phase Appearance - When operating in vehicle actuation mode with vehicle actuated operation, stages/phase shall be serviced in cyclic order in accordance with the sequence data in the controller site specific data. Stages/phases and phases/signal groups appear if a demand has been registered (i.e. latching input) or is currently active (i.e. latching and non-latching input). Stages/phases and phases/signal groups which have a demand registered will not be skipped in any cycle. ■ Fixed Appearance - Entries in the controller site specific data shall provide artificial demands for stages/phases, which have fixed duration. The controller site specific data also provides artificial extension for such stages/phases up to the Maximum Green time. ■ Minimum Green - A stage/phases shall not terminate until the Minimum Green interval has completed timing. Similarly, a stage/phase shall not be terminated until the Minimum Green time for any late-introduced phase/signal group has completed timing, other than, if "late introduced phase/signal group" appears in the following stage/phase and can time its minimum/maximum off through that stage/phase. This applies for all modes of operation. Also, a stage/phase shall not terminate until all pedestrian movements, which are not required to overlap to the following stage/phase, have completed pedestrian green and flashing – steady red timing. This applies for all modes of operation. ■ Fixed Time Operation - The Fixed Time operation or the Vehicle Actuated operation shall be determined on site by the controller site specific data and mode priorities. ■ The Hurry Call mode will provide the means to force the controller to a defined stage, without violating safety clearances. A pre-emption input may be used to demand the Hurry Call mode to give right of way to emergency vehicles, or a queue detector input may be used to demand the Hurry Call mode to prevent blockage of a junction. The Hurry Call mode must be the highest priority mode of operation and causes all lower modes of operation to be suspended while the Hurry Call is active. ■ The Hurry Call is requested by one of the inputs as configured by the controller site specific data. ■ Operation - The Hurry Call mode shall be implemented in the controller software, rather than entirely by entries in the controller Site specific data. ■ Delay Before Period - The controller shall continue to operate normally during the Hurry Call Delay period, however the status returned to the ATC System will indicate that the controller is in the Hurry Call mode.

	<ul style="list-style-type: none"> ■ Delay After Period - The controller shall immediately after the running of a Hurry Call Stage commence a timer that shall prevent the recurrence of the running of the Hurry Call Stage until after the expiry of the adjustable timer.
Fully Adaptive Control Mode	
7	<ul style="list-style-type: none"> ■ In Fully Adaptive Traffic Control mode, the controller is remotely controlled by the central application. ■ The controller shall facilitate the fully adaptive traffic control executing stage timings as per demand within the constraints of Minimum Green, Maximum Green running period for the stage and Cycle time specified by the central ATCS application during every cycle switching. ■ Control and Monitoring - The central ATCS application shall provide control and monitoring facilities at either a quarter second or one-second resolution as appropriate. The local controller must reply with the status of the current stage/phase, the current stage/Milestone interval and responses to any specific data requests received from the central ATCS application. ■ Change of Mode - The presence of a demand for a higher priority mode shall cause the controller to change to the higher priority mode, i.e. the Hurry Call mode or Manual mode. The controller shall change to the "Fallback" mode, previously specified by the central ATCS application, when there is loss of communications with the central ATCS application for a number of seconds. Bidder shall specify the period of time of loss of communication for their specific system. ■ System Monitoring - The central ATCS application shall monitor and control the operation of controllers at intervals of not greater than once per second dependent upon their system characteristics. The monitoring facilities and commands of the central ATCS application shall be independent of the local traffic signal controller operating modes. The local traffic signal controller will return normal status information at the specified intervals relevant to system operation and additional information as requested regardless of operating mode. Each local traffic signal controller shall be capable of returning indications of status at the specified system interval to the ATCS application for the following entities:- <ul style="list-style-type: none"> ✓ Signal Lamps On/Off ✓ Lamp Fault ✓ Controller Fault ✓ Controller Hurry Call ✓ New Entry in Fault/Error Log ✓ Current Stage/Phase ✓ Current Stage/Phase Demands ✓ Fall Back Mode ✓ Pedestrian Demands ✓ Alarm Status for Special Facilities ✓ Safety Fail Red 1 ✓ Safety Fail Red 2 ■ Status for other entities may also be returned to the FATC mode computer once per system timing interval upon request for such information from the FATC mode Computer. Some of these additional status signals are: <ul style="list-style-type: none"> ✓ 1) Detector Status ✓ 2) Phases/Stage Displaying Green ✓ 3) Miscellaneous Status (Control) Flags ✓ 4) Cableless linking Plan ✓ 5) Controller Clock Time ■ The central ATCS application shall also provide a variety of other commands for transferring data to or from the local controller. These shall include but are not be limited to:- <ul style="list-style-type: none"> ✓ Controller Clock Time ✓ Controller Clock Calendar ✓ Cableless linking Plan Data ✓ Cableless linking Timing Data ✓ Controller Fault Log Entries ✓ Lamp Faults ✓ Detector Faults

	<ul style="list-style-type: none"> ✓ Pushbutton Faults ✓ Miscellaneous Status Signals ✓ Send/Receive Text to/from Portable System Terminal ✓ Detector Status Conditions ✓ Monitor Pedestrian Movement Status <ul style="list-style-type: none"> ■ Stage/phase Change Commands - The controller will move to the stage/phase commanded by the central ATCS application, subject to safety interlocks such as pedestrian termination, upon receipt of the change stage/phase command. Each stage/phase shall be configurable to have conditional, or alternative phases/signal groups. The phases/signal groups which appear in the stage/phase may also be configured to be conditional on demand status or on any control signal or other condition that can be tested by the condition tables in the site specific data. ■ Flashing Amber/Flashing Red Mode - If the controller is unable to operate in any mode, because of a fault condition, then the controller shall switch off the signal lamps and flash the amber/red displays. Any fault condition, which jeopardizes the safe operation of the signals, shall place a FAULT entry in the controller Fault/Error Log. Such faults shall cause the controller to enter the Flashing Amber/Flashing Red mode. Faults which do not jeopardize the safe operation of the signals will place ERROR entries in the Fault – Log but shall not cause the controller to enter the Flashing Amber/Flashing Red mode. ■ While the controller is in the Flashing Amber/Flashing Red mode as a result of a major fault, the Central ATCS application, by monitoring the responses of the local controller, will isolate it from its control. ■ The "Flashing Amber/Flashing Red" mode shall be entered if a Fault is detected, such as conflicting signal displays. The Fault Log shall provide a diagnostic which shall identify the reason for entry to the Flashing Amber/Flashing Red mode. ■ Night-time Flashing Amber Mode - It is normal practice to revert local controllers to flashing amber/flashing red signal aspect sequences at night once traffic conditions have subsided. The ATC System computer shall be capable of calling this specific requirement through appropriate timetable operation and the calling of specific Nighttime Flashing facilities.
Time of Day Control Mode	
8	<ul style="list-style-type: none"> ■ The controller shall have facility to configure each day of the week with different day plans. It shall also be possible to set any of the day plans to any day of the week. The controller shall have the capability to configure 20 days plans.
9	<ul style="list-style-type: none"> ■ The controller shall have facility to configure a minimum of 20 days as special days in a calendar year.
10	<ul style="list-style-type: none"> ■ During power up, the controller shall initially execute the Solid Red / Flashing Amber / Flashing Red plan for a time period of 3 Seconds to 10 Seconds as a safety measure.
Safety Operation	
11	<ul style="list-style-type: none"> ■ Shall identify a communication failure with the central computer within a specified time period. In such an event the signal plan timings shall be executed from the local timetable stored in the traffic signal controller FLASH memory. Fallback mode of the traffic signal controller shall be fixed timing plan. On restoration of the communication with central computer the traffic signal controller shall automatically resort to adaptive mode.
12	<ul style="list-style-type: none"> ■ Immediately after the Starting Amber all the approaches should be given red signal for a few seconds before allowing any right of way, as a safety measure. The controller shall have programmability of 3 Seconds to 10 Seconds for All Red signal.
13	<ul style="list-style-type: none"> ■ The controller shall have a facility to list all conflicting phases at an intersection. The controller should not allow programming of these conflicting phases in a Stage. A hardware failure leading to a conflict condition (due to faulty devices or short circuit in the output) shall force the signal into Flashing Amber / Flashing Red.
Reporting Function	
14	<ul style="list-style-type: none"> ■ The traffic signal controller shall report the following to the Central Computer through the communication network every cycle or on an event as appropriate. Green time exercised for each approach (stage pre-emption timing) against the Green running period set for the approach by the Central Computer ■ Mode of Operation: <ul style="list-style-type: none"> ✓ Lamp failure, if any

	<ul style="list-style-type: none"> ✓ Output short circuit, if any ✓ Detector failure, if any
Networking Function	
15	<ul style="list-style-type: none"> ■ The controller shall be capable of communicating with the ATCS application through IP on a managed leased line network or any other appropriate stable communication network.
Other Functions	
16	<ul style="list-style-type: none"> ■ The traffic signal controller shall have a facility to regulate the intensity of signal lamps during different ambient light conditions

5 Hardware Requirement

All hardware equipment shall as a minimum, meet all the requirements listed in the specifications. The equipment's provided shall accommodate to future technological advances which exceeds the minimum requirements provided in the specifications.

5.1 Controller

Table 5-1: Hardware requirement of Controller

No.	Requirements
1.	<ul style="list-style-type: none"> ■ The same controller shall be proposed for both Signal and Pelican locations. ■ Shall have minimum 32bit micro-processor with solid state traffic signal lamp switching module that has the ability to program any combination of traffic signal stages, phases junction groups. and ■ The solid-state switches used shall be able to drive loads consisting of resistive and inductive elements. That is, the lamp switching outputs shall be able to drive LED. All phase/signal group outputs must be rated accordingly.
2.	<ul style="list-style-type: none"> ■ Shall have in-built CPU and all required hardware to facilitate vehicle control at an intersection in a single rack.
3.	<ul style="list-style-type: none"> ■ Shall have a conflict monitoring interface to monitor, notify and resolve the conflicts at programming stage itself and even during the phase of manual over-ride.
4.	<ul style="list-style-type: none"> ■ Shall have the facility to store the site-specific configuration data in a non-volatile memory device (FLASH memory). ■ This data will comprise non-volatile time settings and data tables required to configure the operation for the particular junction or intersection. ■ The data stored in the memory unit shall be protected by a checksum test. ■ The site-specific configuration data shall be prepared on a PC based configuration platform. Data in the site-specific data FLASH memory shall correspond to hardware programmed intersection number and revision level in the controller housing, for the controller to start operation when mains power is applied. ■ The controller shall check the FLASH memory for integrity at power up. All the data stored in volatile memory will be cleared if any corrupted locations are detected. In such a case the controller will use the non-volatile time settings stored in the memory unit. ■ The data in any battery backed RAM will also be verified by a checksum test and also by range checking to ensure that the data has not been corrupted.
5.	<ul style="list-style-type: none"> ■ A minimum of 512KB flash memory and 128KB RAM shall be provided.
6.	<ul style="list-style-type: none"> ■ Each phase/signal group must be configurable to any of the normal displays described below. The normal displays are:- <ul style="list-style-type: none"> ✓ Red, green, Amber (3-aspect vehicle signal); ✓ Red, Green, Flashing Red or Red (pedestrian signal). ✓ Flashing Amber (to main roads), Flashing Red (to side roads), Flashing Red Man to pedestrians. ✓ Filter Green Arrow for left turning traffic; ✓ Filter Green Arrows for left, ahead and right traffic; ✓ Filter Green Arrow for right turning traffic (see above); ✓ Flashing Filter Amber arrows for left turning traffic.

	<ul style="list-style-type: none"> ■ The controller configuration FLASH memory shall provide for filter green arrow for left or right turning traffic. The filter green left or right arrow may have an associated vehicle phase/signal group and can be configured such that it will not terminate until right of way for the associated vehicle phase/signal group is granted. Where a filter green arrow phase/signal group is defined as having 3 aspects, it shall not be possible for the phase/signal group to terminate from green to red without intermediate amber. ■ The controller configuration FLASH memory shall provide for flashing filter amber arrow for left turning traffic. The filter amber left turn arrow may have an associated vehicle or pedestrian phase/signal group and can be configured such that it will not terminate until right of way for the associated vehicle or pedestrian phase/signal group is terminated.
7.	<ul style="list-style-type: none"> ■ The Controller shall provide facilities for a number of stages/phases or phases/signal groups, which may include all red stages/phases. The available phases/signal groups are allocated to these stages/phases or phases/signal groups in any combination subject to the method of control, with the traffic characteristics and safety considerations as necessary to meet the individual site requirement. ■ The controller shall provide at minimum stages/phases, within which any combination of phase/signal group displays are permitted in any stage/phase. Phases/signal groups shall be able to be specified for simultaneous appearance within a stage/phase, for appearance after a specified delay, or for early termination within a stage/phase. It shall also be possible for phase/signal group displays to overlap a number of stages/phases. Specified phases/signal groups shall also be able to provide Leaving Amber and All Red displays independent of the running stage/phase. ■ Each stage/phase shall be capable of conditional and alternative phase/signal group displays, as defined by condition table entries in the controller site-specific configuration data. ■ Complex phase/signal group or staging/phasing designs shall be possible with the appearance of phases/signal groups in multiple stages/phases being conditional on specified conditions at the junction, such as presence of particular demands or the state of special control signals. ■ Conditioning - Each stage/phase shall be configurable to appear automatically or upon demand from specified detector inputs within the controller. ■ Sequence – In vehicle actuated mode, stages/phases shall appear as demanded. When all demands are present, stages/phases shall normally appear in cyclic order. During computer, cable linking or manual modes stages/phases shall normally appear as called. When the controller is operating in the cableless linking mode the sequence of stages/phases shall correspond to the specified plan data stored in the traffic signal controller and must be fully configurable by operator entries from an operator terminal, (with the appropriate level of security, password or pin number). ■ The controller shall provide facilities for a combination of phase/signal group equipment any or all of which may be:- <ul style="list-style-type: none"> ✓ fully actuated by on street demands and extensions. ✓ demand dependent (vehicle or pedestrian Phases) ✓ fixed time phases (vehicle or pedestrian Phases); ✓ Hurry call or other priority calls demand; ✓ Fully Adaptive Control ■ Each phase/signal group may provide control for one of the following: - <ul style="list-style-type: none"> ✓ vehicular movements. ✓ pedestrian movements. ✓ vehicular movements controlled by Green Arrow signals. ✓ vehicular movements controlled by Amber Arrow signals. ✓ dummy phase. ■ A dummy phase/signal group is used where timings or detector operation have to be associated with a particular traffic movement which is not uniquely signaled. It may be used to provide suitable time periods or to condition stage/phase changes even though no signal aspect is associated with the phase. ■ The controller shall respond to vehicle detectors with associated phases/signal groups which may be:- <ul style="list-style-type: none"> ✓ demand a phase/signal group. ✓ extend a phase/signal group.

	<ul style="list-style-type: none"> ✓ demand and extend a phase/signal group. ✓ introduce a hurry call facility. ✓ be associated with an all red condition. ✓ demand via call/cancel. ✓ priority demand of stage/phase; ✓ uni-directional demand for stage/phase; ✓ speed measuring extensions. <p>■ All Red - The controller shall allow any stage/phase to be specified as an All Red stage/phase.</p>
8.	<p>■ Timers shall be allocated to phases/signal groups. The timers shall control the following timed periods of each phase but shall not be limited to only these:-</p> <ul style="list-style-type: none"> ✓ minimum green time. ✓ extension time; ✓ maximum green time. <p>■ Timers shall control the appearance and disappearance of phases/signal groups during the interstage period. Such timers shall generate the phase/signal group to phase/signal group intergreen periods and introduce any further delays to offset phases/signal group with respect to the stage/phase end point.</p>
9.	<p>■ The vehicle actuated controller shall provide the following safety features:</p> <ul style="list-style-type: none"> ✓ Self-Diagnosis on Power up and Run Time ✓ Green-Green Conflict Monitoring ✓ Lamp-Failure-Short Circuit Monitoring ✓ Battery Voltage Monitoring ✓ Automatic Selection of Flashing Program on error Conditions and Communication Failures ✓ Error Logs sent to Traffic Monitoring Centre when networked
10.	<p>■ Controller User Interface:</p> <p>■ Facilities within the Controller Cabinet - Access to the controller housing shall be by a controller key, which fits a secure, vandal proof compression lock at the top and bottom of the traffic signal controller opening door.</p> <p>■ Facilities - Facilities either external to the cabinet door or located inside the controller casing beneath a flap secured by key shall permit the local controller lamps to be switched On or Off, to select Night-Time operation, to assume Normal Operation (modes priorities) and to permit the selection and control of Manual mode.</p> <p>■ Monitoring - The controller front panel shall display Red, Amber and Green LEDs for each phase/signal group output to allow easy monitoring of the drive signals to the signal displays. Status LEDs shall be provided to give indication of the state of the hardware and software. The status LEDs include:-</p> <ul style="list-style-type: none"> ✓ CPU is operating normally ✓ Conflict detected ✓ Communications synchronised ✓ Power is OK ✓ Lamp Alarm (i.e. a lamp fault exists) ✓ System Shutdown (due to an internal system fault)
11.	<p>■ Controller Safety and Reliability:</p> <p>■ Fault Detection - The controller must employ a number of different fault checking processes, including both hardware and software checks using the processors. In general, the signal displays must be switched off within 500 milliseconds of the occurrence of a fault. There are exceptions to this as noted below.</p> <p>■ The occurrence of a conflict in signal displays will cause the signal displays to be switched to flash amber/flashing red within 150 milliseconds by the conflict monitor. Configuration faults, which cause unsafe signal displays, must cause the signal displays to be switched off within 100 milliseconds. Examples of this class of fault are: -</p> <ul style="list-style-type: none"> ✓ An attempt to change a signal display from Green to Red without an intervening Leaving Amber display. ✓ Premature termination of a pedestrian signal display from either pedestrian green or flashing red to the pedestrian red. ✓ An attempt to terminate a phase Green display before expiry of the minimum green

	<p>time for the phase.</p> <ul style="list-style-type: none"> √ Invalid site-specific data in a data or condition table. ■ It shall not be possible to alter any basic timing parameters including minimum / maxima from a handset or portable communications device/ Changing such data shall only be possible by changing the controller's EPROM. ■ Software checks shall be performed on the battery backed RAM and also checksum checks performed on non-volatile memory.
12.	<p>Design Life:</p> <ul style="list-style-type: none"> ■ All components must be rated for minimum 10-year life, excluding the standby battery, which shall have a minimum life of 5 years. Also Mean Time Between Failures (MTBF) of greater than 3 years is required.
13.	<ul style="list-style-type: none"> ■ Starting Red/Amber sequence facility shall be available for use as and when required. ■ The duration of the Leaving Amber intervals shall be configurable in the range 3 to 8 seconds and normally set to 4 seconds. ■ A flashing red/or steady red pedestrian clearance display shall be provided, to terminate the right of way for pedestrian phases. ■ Phase/signal group Minimum Green shall be provided to prohibit a phase/signal group losing right-of-way until a minimum safety period, defined as the minimum green period has expired. It shall not be possible to terminate prematurely any minimum period. At the commencement of a phase/signal group green, the minimum green period of that phase/signal group shall start to time off immediately in the presence of an opposing demand. ■ Minimum Green Expiry Period – A stage/phase change may occur after the expiry of the last phase/signal group minimum green for a phase/signal group or phases/signal groups which will lose right-of-way on a change to the next stage/phase to be introduced, providing no extension requests exist for the terminating phases/signal groups. Phase/signal group minimums may still be running when the stage/phase change occurs providing the associated phases/signal groups run in the new stage/phase. The duration of the stage/phase minimum green period will be determined by the expiry of the minimum periods of the phases/signal groups which will lose right-of-way upon the change to the next stage/phase. ■ Vehicle Phase/signal Group Green Extensions – The passage of a vehicle over a detector loop as indicated by a detector unit which normally demands a phase/signal group may, during the green period of that phase/signal group, cause a green extension to be generated for that phase/signal group. The continued output from the detector or detectors associated with a phase/signal group shall hold that phase/signal group green signal; the cessation of the output from the loop detector shall normally terminate the green extension request after a fixed period – the extension time. If at the end of the extension time the stage/Milestone 1s held by extensions associated with another phase/signal group, further extension requests shall be permitted (these are the minimum criteria which may be supplemented with further facilities). ■ It shall be possible to arrange that selected detector inputs do not extend a phase/signal group during a single selected stage/phase. ■ It shall be possible for the relevant phase/signal group green signals to be terminated before extension inputs that have been accepted are actioned or legitimately overridden by Maximum or ATC influence. ■ In the absence of continuing extensions for all currently running signal groups/phases the controller shall move to a nominated phase/stage when the following conditions are satisfied: <ul style="list-style-type: none"> - √ A demand for right-of-way for a conflicting phase exists and; √ The minimum green running periods of phases which will lose right-of-way have expired and; √ The vehicle green extension timers have expired on all phases/signal groups, which will lose right-of-way upon the change to the next stage/phase. ■ The maximum green running period shall be provided for each vehicle actuated phase/signal group. When a phase/signal group obtains right-of-way, the maximum green running period shall commence to time off immediately if there is a demand for any conflicting phase/signal group, or, if there is no conflicting demand present, it shall commence to time off upon the receipt of a subsequent demand for any conflicting phase/signal group.

	<ul style="list-style-type: none"> ■ The effect of this facility shall be to limit the duration of a phase/signal group before the controller may allow right-of-way to terminate in order to introduce a conflicting phase/signal group. The maximum duration of a particular stage/phase green shall be governed by the termination of the last associated phase/signal group if more than one phase/signal group is to be terminated by the stage/phase change and if the maxima for these phases/signal groups are different. ■ Alternative values of maximum running periods shall be available. These alternative maximum running periods shall be able to be introduced via timetables / external detection/ modes of control and be fully adjustable between the predefined controller upper and lower timing limits. ■ The duration of the green split period shall be determined by the control mode in which the controller is in. ■ After the termination of the last phase/signal group maximum green for phases/signal groups not served by the next stage/phase to be introduced, a stage/phase change shall occur to serve the conflicting demanded phases/signal groups. This change may take place irrespective of whether the maximum or minimum green periods for the phases/signal groups also served by the new stage/phase have expired. ■ It shall be possible for a phase to receive right of way at any time in the stage/phase or combination of phases /signal groups after the beginning of the stage/phase or combination of phases/signal groups Minimum Green interval. ■ The phase/signal group shall not be permitted to terminate while any Minimum Green timers are active, thus ensuring that the phase(s)/signal groups are not terminated without running the required Minimum Green time. ■ For pedestrian phases the pedestrian green time setting will provide the Minimum time on a phase/signal group by phase/signal group basis. ■ Phase/signal group intergreens between conflicting phases/signal groups shall be specified and shall influence the starting and ending of stages/phases where stage/phase control is appropriate. (The intergreen period is the period between one phase/signal group losing right-of-way and another phase/signal group gaining right of way.) It shall be possible to allocate individual intergreen timing values to all conflicting phase/signal group transitions. Intergreen values shall not be violated in the event of multiple stage/phase changes. ■ Phase/signal Group Change Delays/Advances – the controller shall have the facility to delay the disappearance of any phase/signal group with respect to the end of a stage/phase or combination of phases/signal groups at any stage/phase to stage/phase transition. Such delays shall be of defined fixed durations. The controller shall also have the facility to advance the appearance of any phase/signal group. ■ Following the leaving amber period, the phases/signal groups losing right-of-way shall change to red. The controller shall include the facility such that during any stage/phase to stage/phase change a red condition can be generated simultaneously on all phases/signal groups which change their right-of-way condition at the stage/phase to stage/phase change. The necessary timing for such an all red condition shall be generated from the values of the intergreen timing parameters and any related phase/signal group delays allowing for mandatory amber periods. ■ Extended Red Periods – the timing of the stage/phase to stage/phase movement shall be capable of being increased by red extending detectors. ■ The controller shall provide a separate Delay interval and time setting for each pedestrian phase/signal group to allow delayed introduction of the pedestrian green display. ■ Limiting Values – minimum green and intergreen timings shall each be protected by a single minimum value stored in FLASH memory, it shall be possible to arrange that this value is considered a standard value below or above which it shall not normally be permitted to specify. These standard values shall be user configurable at an appropriate password level or other appropriate means. Unless otherwise specified limiting values for minimum green shall be 8 seconds and for intergreens 5 seconds.
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5.2 Vehicle Detectors

No.	Requirements
1.	Functionality: <ul style="list-style-type: none">■ Identifying and communicating the adaptive algorithm specific traffic data over a specified area of detection in day/night and all-weather conditions.■ Detector interface to communicate with controller to support adaptive control operations and send the traffic and timing data to control room in real-time.■ View traffic counts on a laptop connected at site in real-time.■ Facilitating the estimation of turning demand and traffic characteristics over time.
2.	■ The type of vehicle detectors shall be camera type using image processing.
3.	■ Shall cover at least 4 lanes with simultaneous detection of vehicles in all the 4 lanes.
4.	■ Shall transmit the relevant data (at minimum traffic counts and signal timings) to control room with maximum lag period of 3s
5.	■ Shall have refresh timings better than 75ms
6.	■ Shall have the flexibility of installing it by attaching with or mounting on roadside features such as gantry, signal poles etc.
7.	■ Shall have 92% detection accuracy for counting.
8.	<ul style="list-style-type: none">■ The detector shall have the ability (with required ports) to transfer HD quality video, with necessary compression, to the control room in real-time.■ The detector shall have capability to measure the real-time traffic flow monitoring including counting, classification, flow speed and zone occupancy.

5.3 Controller Cabinet

Table 5-2: Hardware requirement of Controller cabinet

No	Requirements
1.	■ Provide the housing of various equipment such as controller, detector cards, flasher, DC power supply, circuit breakers and AC power, signal monitor, switch packs, and flash transfer relay as shown below.
2.	■ Shall be located along minor street approach to provide ease of viewing inside the cabinet and display of signal indications, trouble shooting, and carrying out the filed observations, simultaneously.
3.	■ Installation spot shall be away from roadway to minimize the likelihood of crashes.
4.	■ All schematic wiring diagrams of the controller units and auxiliary equipment, all cabinet diagrams and all operation manuals shall be submitted at the time the controller assemblies are delivered. The diagrams shall show in detail all circuits and parts.
5.	■ Conductors within the traffic signal cabinets shall be neatly arranged and shall be cabled together with self-clinching nylon cable ties, or other similar equal method.

6.	<ul style="list-style-type: none">■ The cabinet shall be electrically and mechanically robust and shall have a degree of protection of IP65 or higher specified in “IEC60529 Degrees of Protection Provided by Enclosures (IP Code)”.■ The cabinet shall have the provision for temperature controlling for optimal performance of equipment.■ A right hinged door shall be provided on the front to realize easy maintenance work. The turning direction of the handle shall be counterclockwise.■ Tamper Alert: The Controller and its cabinet should have facility of generating & dispatching door open alarm to Control Room every time the Controller-cabinet door is opened. This alarm can be silenced by either the maintenance personnel on site (by pressing another button/switch in controller/controller-cabinet) to indicate Controller-cabinet is opened by authorised personnel for maintenance or by Control Room operator by accepting the alarm at Control Room after confirming with the Site personnel carrying
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No	Requirements
	<p>out the maintenance activity on site</p> <ul style="list-style-type: none"> ■ The power supply including UPS shall be provided with a circuit breaker. ■ The anti-lightning and surge protection complying with the IEC61643-1 shall be provided. ■ Protection under/overvoltage condition shall be provided. ■ Monitoring status of temperature, battery and power supply ■ The cabinet shall be finished with the anticorrosive treatment ■ An internal lighting system ■ 220VAC plugs protected by a differential circuit breaker ■ An intercom jack ■ A file holder for the documentation ■ Standard key locks ■ Fixed on metallic cabinet frames (when false floor)

5.4 Network Infrastructure

The Contractor shall supply and install network equipment at each location to connect each peripheral to the system. The Bidder shall supply and install all equipment, cables, connectors, terminals and other miscellaneous materials necessary to establish a working local area network connecting these systems. The network between the Control Center and sub-systems shall either use the optical fibre cable network or high-end Wireless Access Points along the Project Area and a data communication network shall be established using layered switches to be supplied by the Contractor.

The type and the number of the network equipment proposed by the Bidder as per the network design shall be mentioned by the Bidder in the BOQ. The network configuration shall be determined by the Bidder. The cost of the network devices and materials that is not explicitly listed in the BOQ of the Bid submitted by the Bidder or supplied by the Bidder during the installation works but deemed necessary for the system during any stage of this Contract shall be included in the cost of appropriate items and the Contract Price, and no separate payment shall be made.

5.5 Industrial Grade Layer -2 Switch

Table 5-3: Hardware requirement of Industrial grade Layer-2 switch

No.	Item	Requirements
1	Ethernet Interfaces	4 x 10/100/1000 Base-T PoE+ Ports auto-negotiation Plus 4 x 1000 Base-X SFP Uplink Slots (Should be loaded with 2 x 1G Single mode Industrial Grade Fiber Modules supports up to 10 Km)
2	Performance	Switching fabric 16 Gbps or more Forwarding rate 11.8 Mpps or more
3	PoE Budget	120 Watts
4	VLANs	512
5	Level 2 switching	IEEE 802.1, 802.3 standards, NTP, UDLD, LLDP, Unicast MAC filter, LACP, Private VLAN, Voice VLAN, VLAN double tagging (QinQ), STP, RSTP, MSTP, GARP, GMRP, GVRP, SNMPv1/v2c/v3, SNMP Inform, DHCP Server/Relay/Client, DHCP Option 66/67/82, BootP, RARP, TFTP, RMON, HTTP, HTTPS, Syslog, MRP (Client), LLDP, 802.1x, NetFlow/sFlow, port mirroring, Digital Diagnostic Monitoring (DDM)

6	Quality of Service (QoS)	Rate limit, auto QoS, ingress policing, egress queuing, and shaping
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No.	Item	Requirements
7	Multicast	IGMPv1, v2, v3 snooping, IGMP filtering, IGMP querier, MLD snooping v1, v2
8	Management	ICMP, Telnet, SSH, ARP, Syslog, SNMPv1/v2, RMON, SMTP, HTTP, HTTPS IPv4, IPv6
9	Security	Port security, 802.1x, Dynamic VLAN assignment, Dynamic Host Configuration Protocol (DHCP) snooping, dynamic ARP inspection, IP Source Guard, storm control - unicast, multicast, broadcast, SSH, SNMPv3, TACACS+
10	Power Input Voltage	12 to 56 VDC with Redundant dual power inputs with 5-PIN Lockable Terminal Block
		Reverse Polarity Protection
11	Warranty	Min 5 years
12	Power Supply	Bidder should provide Industrial Grade AC/DC DIN RAIL power supply.

5.6 SFP Transceiver

Table 5-4: Harwadew requirement of SFP Transceiver

No	Item	Requirements
1	Media Type	Single-Mode or compatible with operator's network to be surveyed by bidder
2	Data Rate	1250 (Mbps)
3	Grade	Industrial

5.7 Din Rail Power Supply

Table 5-5: Harware requirement of Din rail power supply

No	Item	Requirements
1	Input Voltage	180~240VAC
2	Input Frequency	50~60Hz
3	Output DC Voltage	48VDC±10%
4	Rated Current	2.5Amp
5	Current Range	0 ~ 5Amp
6	Rated Power	120W
7	Voltage Range	48~53VDC
8	Over-Voltage Protection	55~60VDC
9	Mounting Style	DIN Rail
10	Warranty	2 Years
11	Grade	Industrial

5.8 Power Supply and Outdoor UPS

Power supply and UPS shall be provided at each ATCS location. The Bidder shall present the calculation of power consumption and capacity of power supply system to be used for the ATCS system. The Bidder shall also consider the power requirement of network devices, wireless access points, switch, etc. suitably during the calculation. Proper earthing shall be provided at

each equipment location.

The type and the number of the Power supply, Electric Meter proposed by the Bidder as per the design shall be mentioned by the Bidder in the BOQ. The cost of the Power Supply devices and materials that is not explicitly listed in the BOQ of the Bid submitted by the Bidder or supplied by the Bidder during the installation works but deemed necessary for the system during any stage of this Contract shall be included in the cost of appropriate items and the Contract Price, and no separate payment shall be made.

Table 5-6: Hardware requirement of Outdoor UPS

No.	Item	Requirements
1.	Input / Output Voltage	<ul style="list-style-type: none"> ■ AC 230 V / 50 Hz basically. ■ Output voltage: AC230V/50Hz ■ Commercial Power generally but with existing condition of power failure, instantaneous power failure and voltage fluctuation
2	UPS	<ul style="list-style-type: none"> ■ The UPS shall be of True online with double conversion topology. ■ The UPS shall work in outdoor environment to ensure all equipment's getting necessary power supply. No power surge. ■ The UPS unit shall have load level indicators that display the approximate electrical load placed upon the UPS. The UPS unit shall have a row of battery level indicators that display the approximate battery capacity. ■ The UPS unit shall have a minimum of the following as per OEM standard indicators: <ul style="list-style-type: none"> ➢ UPS Mode: On-line, Backup/Battery and Bypass; ➢ Over Load Indicator: This will display when UPS is running on overload; ➢ Battery Status Indicator: This will illuminate when battery is low or faulty/disconnected; and ➢ System Fault: This will illuminate when there is some fault or interruption in UPS. ■ The UPS unit shall include Ethernet communication port to support remote management and monitoring capabilities using SNMP including alarm contacts and remote shutdown. Remote monitoring and testing software shall be included. The manufacturer shall provide all SNMP traps. ■ The UPS unit shall include automatic restart. Upon restoration of utility AC power after complete battery discharge, the UPS shall automatically restart and resume operation. ■ The UPS unit shall be compliant to IEC 62040-1, CE, IEC602040-2 safety standards. ■ The UPS and batteries shall be mounted in a separate cabinet & the enclosure shall be under lock & key, utilising the minimum possible space and arranged in an aesthetic manner. ■ Any field UPS system (as per MSI's design) shall be supplied with an environmentally rated cabinet for installation of the UPS and batteries. The cabinet shall have a rating of IP 55. The cabinet shall be supplied with in-built fans and proper ventilation as needed to ensure that the temperature inside the cabinet does not exceed 40 degrees C at any given point in time. ■ Backup time at least 3 hrs or more

5.9 Traffic Signal Pole

Table 5-7: Hardware requirement of Traffic signal pole

No.	Requirements
1.	<ul style="list-style-type: none"> ■ Functionality: To provide adequate structural support and stability to signal heads. Signal poles shall be of a uniform diameter. An exception may be made to increase the diameter of the lower part of any pole at a signal installation to accommodate, for example, electrical services and/or termination assemblies. ■ Poles shall be shotblasted with a crossover adhesive and dipped in a fluidized bed of PVC, to a thickness of 250/300 microns with a bitumen finish applied to the internal surfaces of the pole, alternatively a fully galvanized pole in accordance with EN ISO 1461 or to a similar International standard shall be provided. All poles shall be polyethylene sleeved for protection. All signal poles shall include plastic coatings and shall be even when scratched or torn resistant to peeling. ■ The use of short poles for push button units only and cranked poles for areas where pedestrian walkways are restricted may also be used. ■ The interior of the steel poles shall be protected by: - <ul style="list-style-type: none"> ✓ a finish complying with the requirements of EN ISO 1461 or equivalent International standard as appropriate for use in India. ✓ an anti-corrosive paint which shall be effective over the temperature range minus 25 deg C to 70 deg C ■ All non-current carrying metal parts used to support the terminal assembly and the bonding for cable earth leads shall be non-corrodible and earthed in accordance with the current requirements of the IEEE (or equivalent) wiring regulations or similar International standards as appropriate for use in India. Any method of terminating armored cables shall ensure electrical earth connection between the frame supporting the terminal assembly and the metal of the signal pole shall be firm and shake proof. The terminal assembly support frame shall resist vibration fatigue when supporting its full complement of cables and terminal blocks.
2.	<p>Standard Pole</p> <ul style="list-style-type: none"> ■ Shall be made of Galvanized steel Class B material, complying with EN ISO 1461 standard or similar international standard. It should also comply with following minimum specifications. <ul style="list-style-type: none"> ✓ Dimension - Height 6000mm, Diameter 115mm, Thickness 4.4mm, ✓ Base plate - Size 200 mm x 200 mm x 16 mm thick with foundation accessories ✓ Paint- Refer to General Requirement
3.	<p>Cantilever Pole</p> <ul style="list-style-type: none"> ■ Shall be made of Galvanized steel Class B material, complying with EN ISO 1461 standard or similar international standard. It should also comply with following minimum specifications. <ul style="list-style-type: none"> ✓ Dimension (H) - 6500mm above ground level including Foundation, Diameter 115mm, Thickness 4.4mm, ✓ Base Plate - Size 300 mm x 300 mm x 26 mm thick with foundation accessories ✓ Paint - Refer to General Requirement ✓ Length of Cantilever arm – 6000mm
4.	<ul style="list-style-type: none"> ■ All signal poles shall be placed a minimum of 0.50 meters from face of the pole to the edge of the pavement. Poles shall be as close to the intersection as practical to allow other attachments such as pedestrian equipment.
5.	<ul style="list-style-type: none"> ■ Poles shall not be disrupting pedestrian crosswalk and/or sidewalks and shall consider any restrictions or constraints derived from utility clearances requirements.
6.	<ul style="list-style-type: none"> ■ Poles shall include provision for electrical constructions in the form of holes and hand holes of adequate size positioned at least 0.3 meters above the base plate and at the mast

No.	Requirements
	arm mounting level. The hand holes shall be adequately reinforced and shall be properly covered.
7.	■ The selection of Signal pole/Cantilever/Gantry must be based on providing the signal heads in the centre of the carriageway for the movement. In addition, general practices in India of using Signal Pole as primary and Cantilever as secondary must be followed; except if a signal pole satisfies the requirement better for a given location.
8.	■ Bidder shall supply and mount all poles (Standard/Cantilever/Gantry type) and mast arms (to cover the traffic lanes as per site) needed to support traffic and pedestrian signal heads, TSP equipment and detection equipment.
9.	■ Bidder shall build the foundations needed for mounting poles and pedestal. Materials, labour, and equipment needed to build up foundations shall be included in the proposal.
10.	■ Suitable means shall be provided to firmly fasten brackets and signal heads to poles, and to allow adjustment where required. All nuts, bolts, fastening, hinges, brackets and other fittings shall be of non-corrodible material or suitably treated to prevent corrosion. All nuts used for fastening signal heads to brackets / poles shall be of a anti vibration type e.g., Nyloc nuts or equivalent.
11.	■ Poles shall be plumbed by the Contractor so that they are vertical when viewed from all directions. The plumb will be checked by the Engineer and the Contractor shall make any adjustments which are necessary by installing levelling shims as required around the anchor bolts.
12.	■ Vehicle signal heads shall normally be fixed with the center of the amber aspect 3.5 m above the carriage way level. Signal heads on high masts shall be fitted so that the lower part of the signal head assembly is at least 5.5 m above the carriage way surface, or as directed by the Engineer. Pedestrian signal heads shall be fixed with the center of the Red Man aspect 2.3 m above the carriage way level or as directed by the Engineer.
13.	■ Termination of signal cables may be brought to a terminal strip mounted within a pole-mounted box attached to the signal pole some 1.2 metres above ground level. Cables connected permanently in the signal heads shall also be brought through the inside of the pole into the termination box and terminated there. Earthing between the terminal and pole shall include terminal box door and internal connection arrangements. The termination box shall be rated to IP67 or better.
14.	■ Pedestrian push-button boxes shall be mounted with the push-button 1.2m from pavement level and shall be earth bonded to the supporting pole. The mounting shall be such that the box cannot slide on the pole if the fixings become loose. The boxes shall contain suitable terminals for controlling cables, which shall be routed inside the pole.

5.10 Pole Foundation

Table 5-8: Hardware requirement of Pole foundation

No	Requirements
1.	Functionality: To provide adequate structural support and stability to Traffic Signal Poles
2.	Exact design and dimension of the foundation shall be determined by the Contractor as per the design of the pole and as per the site conditions.
3.	Bidder shall build the foundations needed for mounting poles and pedestal. Materials, labour, and equipment needed to build up foundations shall be included in the proposal
4.	The location of existing detectors, conduits, pull boxes and other facilities shall be determined before using any tools or equipment that may damage those facilities
5.	Tops of foundation for poles, and traffic signal cabinets shall be finished to curb or sidewalk grade or as directed by the Engineer. Conduit ends and anchor bolts shall be placed in proper position and at proper height, and anchor bolts shall be held in place by

	means of rigid top and bottom templates. The template shall be made of steel and anchor bolts, bars, studs or nuts made of hot dip galvanized iron.
6.	Welding shall not be performed on any portion of the body of high-strength anchor bolts, anchor bars or studs.
7.	All excavations shall be filled, and sidewalks, pavement and landscaping restored.
8.	Foundation is basically pre-casted, but Contractor can propose another type of foundations considering site situation.

5.11 Traffic Signal Aspect

Pedestrian aspects are placed at a lower height compared to vehicular aspects. There are many variations and standards used by various countries on implementation and functioning of pedestrian aspects. Usually, the pedestrian light sequence followed is as below:

- Green man/ light: Safe for pedestrians to cross the intersection
- Flashing red man/ light: Pedestrians shall continue to cross if already in the intersection, but do not start to cross
- Red man/ light: do not cross

Table 5-9: Hardware requirement of Traffic signal aspect

No.	Requirements
1.	<ul style="list-style-type: none"> ■ Functionality: To provide periodic indications towards conflicting vehicle users at intersection thus facilitating right of way (RoW) to them in orderly pattern.
2.	<ul style="list-style-type: none"> ■ Traffic signal lights follow a universal colour code which alternates the right of way accorded to users with a sequence of illuminating lamps or LEDs of three standard colours: <ul style="list-style-type: none"> √ Red - prohibits any traffic from proceeding. A flashing red indication requires traffic to stop and then proceed when safe √ Green - allows traffic to proceed in the direction denoted, if it is safe to do so and there is room on the other side of the intersection. √ Amber (yellow) - warns the road users that the signal is about to change to red, requiring drivers to stop if it is safe to do so, and others allowing drivers to go through the intersection if safe to do so.

3.	<p>■ Shall comply with following requirements.</p> <ul style="list-style-type: none"> ✓ 300mm RED BALL LED aspect 24 V DC with inbuilt voltage / current regulator 400 mA max. including dust and waterproof Polycarbonate housing and clamps ✓ 300mm RED ARROW LED aspect 24 V DC with inbuilt voltage / current regulator 400 mA max. including dust and waterproof Polycarbonate housing and clamps ✓ 300mm AMBER BALL LED aspect 24V DC with inbuilt voltage / current regulator 400mA max. including dust and waterproof Polycarbonate housing and clamps ✓ 300mm AMBER ARROWLED aspect 24V DC with inbuilt voltage / current regulator 400mA max. including dust and waterproof Polycarbonate housing and clamps ✓ 300mm GREEN BALL LED aspect 24V DC with inbuilt voltage / current regulator 400mA max. including dust and waterproof Polycarbonate housing and clamps ✓ 300mm GREEN ARROW LED aspect 24V DC with inbuilt voltage / current regulator 200 mA Max. including dust and waterproof Polycarbonate housing and clamps ✓ 300mm GREEN U-TURN LED aspect 24 V DC with inbuilt voltage / current regulator 400 mA max. including dust and waterproof Polycarbonate housing and clamps
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	<ul style="list-style-type: none"> ✓ 300mm PEDESTRIAN LED aspect - Pedestrian Red Man standing - 24 V DC with inbuilt voltage / current regulator 400 mA max. including dust and waterproof Polycarbonate housing and clamps ✓ 300mm PEDESTRIAN LED aspect - Pedestrian Green man walking - 24 V DC with inbuilt voltage / current regulator 400 mA max. including dust and waterproof Polycarbonate housing and clamps
4.	■ LED Aspects shall have an operating temperature range of -10° C to +55° C
5.	■ LED Aspects shall be designed to work 24/7 in all weather conditions (rain, fog, bright Sun light, etc.) and shall deliver even distribution of luminosity
6.	■ Power factor of the LED aspects shall be greater than 0.9
7.	■ LED Aspects shall be central/single source and have a lifespan of more than 10 years (greater than 80,000 hours)
8.	<p>■ The design of the optical system shall be such that when a signal aspect is installed with its visor, under all normal conditions experienced in Chennai it shall give a clear and unambiguous indication to all road users including buses, goods vehicles and pedestrians when viewed from all normal viewing angles up to a distance of 80 m from the aspect and shall be made from unbreakable polycarbonate. In particular:</p> <ul style="list-style-type: none"> ✓ When an aspect is switched off it shall give a uniform, near black appearance with no visible phantom or spectral reflection. ✓ For the pedestrian and coloured arrow aspects, when switched on, the contrast between the illuminated and non-illuminated portions of the aspect shall be such that the intended indication is completely clear.
9.	<p>■ The materials used and the form of construction used shall be such as to ensure that the signal head (including visors, which are required) has adequate mechanical strength and durability to withstand the conditions of installation, operation and maintenance. It shall be capable of withstanding winds of up to 180 km/h for 3 seconds. The color of the signal body and visors shall be black UV stabilized high impact or impact modified Polypropylene. The lenses shall be acrylic, and reflectors shall be polycarbonate with stainless steel or Polypropylene fixings.</p> <p>■ Materials, fixings and fastenings used shall be inherently corrosion resistant,</p>
10.	■ The signal head shall be of modular construction, permitting signal head configurations to be built from standard building blocks designed to be safe, vandal resistant and easy to install and maintain. It shall comply with the requirements of EN12368, BS1376, DIN6163 or other International Standard appropriate for use in India.
11.	■ The provision of LED signal heads shall be to the specifications detailed in EN12368 (European standard) and the further detailed requirements of TR2206A or other equivalent International Standard appropriate for use in India. The LED signal heads are to be compliant with Class A (-15 to 60) for use in a class A environment, provide a luminosity of intensity of 400cd, have a medium intensity distribution, a luminous uniformity of 1:10, phantom class 5 and an impact resistance of 0.51kg dropped from IR3 (1300mm).
12.	<p>■ Provide a secure locking action to prevent vandalism or movement of the signal head from the locked position.</p> <p>■ The signal heads shall be provided with seals between all openings and these may be supplemented with knife-edge type seals to prevent the ingress of water.</p> <p>■ Visors shall be of sufficient size to adequately shade the aspects and to minimize phantom effects. The visors shall be manufactured from matt black Where specified, or made necessary by site conditions, deep or specially designed visors shall be provided which give a constrained directional view of the signal aspect.</p> <p>■ The signal head shall achieve a precise beam distribution, which produces high intensities of light in the center of the optic. The displayed symbols shall offer some form of protection against the adverse effects of phantom illumination of aspects.</p> <p>■ Brackets shall be pre-drilled to suit and supplied in kit form including fixing kit for standard poles and shall be treated for use in a high salt content atmosphere.</p> <p>■ Fastenings used on signal heads and poles to gain internal access shall not require special tools and shall be wholly captive.</p>

13.	■ Shall be installed with other control fixtures including signs and camera detectors on the signal support as per the Pole Schedule on the Drawings.
14.	■ Drill holes, if any needed for the installation of any equipment including Traffic Signal heads shall be further protected by a rubber grommet.
15.	■ Conductors within poles, pulling boxes or traffic signal cabinets shall be neatly arranged and shall be cabled together with self-clinching nylon cable ties or other method approved by the Engineer.
16.	■ Shall be plumb and securely attached with all fittings so they present a neat appearance. All traffic signal aspects shall hang at the same elevation.
17.	■ Shall be covered with burlap bag or opaque plastic/vinyl bags while mounted and not in operation. Inoperative signals on roads open to the public shall always be covered. Tilting the signals upward is not an acceptable alternative to covering the heads.

5.12 Pedestrian Pelican Push Button and Buzzer

Table 5-10: Hardware requirement of Pedestrian pelican push button and buzzer

No.	Requirements
1.	■ Functionality: To aid pedestrians to cross a signalized intersection or at a mid-block
2.	<ul style="list-style-type: none"> ✓ Audio: Beep buzzer ✓ Working voltage: 12 Volts DC ✓ Body Material: Metal GI Powder coated. ✓ Push button shall be pole mounted as per IRC

6 Communication Requirement

The Communication requirements for ATCS are shown in the table below

Table 6-1: Communication Requirements of ATCS

No.	Requirements
1.	<ul style="list-style-type: none"> ■ Communication between the roadside equipment of ATCS and the ATCS server at Chennai Traffic Information and Management Centre shall be wired connectivity provided by a single communication company. If required MPLS VPN to be provided. ■ The required bandwidth for ATCS to ensure the stable communication connectivity shall be proposed by the Contractor and subsequently approved by the Engineer. ■ Connectivity from ATCS Controller to ATCS Server (Software) - 2 Mbps at each intersection's minimum required

7 Installation Requirement

Table 7-1: Installation requirement of ATCS

No.	Requirements
Removal of Existing Signals	
1	<ul style="list-style-type: none"> ■ The Contractor shall remove the existing signal pole, signal light, cabinet and all other related materials and cables at intersections for installation of ATCS. ■ The Contractor shall coordinate all necessary related stakeholders and prepare the safety measures for the work. ■ The Contractor shall move the removed signals into the Employer's warehouse.

Backfilling Work	
2	■ The Contractor shall carry out the backfilling work after removal of the existing signals at intersections.

No.	Requirements
	<ul style="list-style-type: none"> ■ When backfilling work is carried out the following procedures shall be taken. <ul style="list-style-type: none"> ✓ Before the work, all fallen objects shall be removed from the excavation. ✓ Upon completion of the work, all remaining soil shall be removed and the road surface, pavement and the area concerned shall be immediately cleaned.
Restoration Work of Road and Sidewalk	
3	<ul style="list-style-type: none"> ■ The Contractor shall carry out the temporary restoration so that traffic shall not be interrupted until the permanent restoration is carried out. ■ The Contractor shall ensure the permanent restoration of the road to its original conditions. To do so, the Contractor shall contact the relevant authorities and follow their requirement.
Conduit, handhole and Foundation	
4	<ul style="list-style-type: none"> ■ The Contractor shall carry out all necessary conduit, handhole and foundation work for installation of ATCS.
Installation of Local Controller	
5	<p>The installation method of Local Controller should be either pole-holding-in or self-supporting as follows;</p> <ul style="list-style-type: none"> ■ Use installation brackets and so on suitable to the installation method mentioned above. ■ Conduct grounding work with grounding resistance of 10[Ω] or lower. ■ The keyhole of Local Controller should be 1,300mm from the road surface, in principle.
Installation of Signal Lamp for Vehicle	
6	<ul style="list-style-type: none"> ■ Use installation brackets and so on suitable to those signal lamps and installation method mentioned above. ■ The installation height of signal lamp equipment for vehicles should be 5,500mm or more from the road surface to the bottom surface of lamp. ■ Place the display surface aligning the central axis in the horizontal or vertical direction. ■ Paint the housing with a colour which does not lower the visibility of signal lamp.
Installation of Signal Lamp for Pedestrian	
7	<ul style="list-style-type: none"> ■ The installation method of signal lamp equipment for pedestrians should be side-pole type. ■ Use installation brackets and so on suitable to the signal lamp equipment and installation method mentioned above. ■ The installation height of signal lamp equipment for pedestrians should be between 2,500mm and 3,200mm from the road surface to the bottom surface of lamp or the lower arm, in principle. ■ Place the display surface aligning the central axis in the vertical direction.
General	
8	<ul style="list-style-type: none"> ■ The Contractor shall make the provision for necessary civil, foundation, earthing, necessary cable conducting, manhole, Power supply, redundant communication, new meter connection, quality, safety and last mile connectivity etc. to meet the functional requirement intended for the system. ■ The Contractor shall obtain necessary permission from respective agency.

8 Intersection Improvement Requirement

Table 8-1: Intersection improvement requirement of ATCS

No.	Requirements
Removal of Sidewalk and/or median	
1	<ul style="list-style-type: none"> ■ The Contractor shall carefully remove the cement concrete kerbs, paver blocks or any other surface material of the portion of the sidewalk and/or median that is to be expanded or reduced and store it safely for reuse in the expanded portion. ■ The Contractor shall dismantle the existing BT Surface and/or drill the cement concrete surface of the carriageway where the sidewalk and/or median expansion is proposed as shown in the drawings.

No.	Requirements																																																																							
	<ul style="list-style-type: none">■ The Contractor shall coordinate all necessary related stakeholders and prepare the safety measures for the work.■ The Contractor shall transport only the unusable debris into a Employer-approved dumping facility.																																																																							
Restoration Work of Sidewalk and/or median																																																																								
2	<ul style="list-style-type: none">■ The Contractor shall lay in the surface of the expanded sidewalk and/or median such that it is matching with the existing continuous surfaces. Dismantled material from other portions of the intersection shall be reused as far as possible for the expansion work.■ Where sidewalk or median is to be removed, the Contractor shall resurface the area with a bituminous layer, footpaths, handrail, median etc matching the level of the surrounding carriageway.■ The Contractor shall ensure the restoration of the road to its original conditions. To do so, he shall contact the relevant authorities and follow their requirement as per approved design by the Employer/Engineer																																																																							
Road Marking, Signages, Footpath& Median extension																																																																								
3	<ul style="list-style-type: none">■ The Road marking, Signages, Footpath& Median extension shall be provided in accordance with IRC 35 & IRC 67.■ The approximate number of Signages, Road marking, Footpath and median extension is shown in the table below, however the Contractor required to perform all the necessary works based on the approved detailed design and BOQ as per the site requirement at the time of installation and approval obtained from the Engineer																																																																							
	Sl.No.	Signages	Qty/ Unit	Approx Nos	1	Signages at ATCS Junction				<ul style="list-style-type: none">• Mandatory/Regulatory circular sign boards (Size of 600mm dfa)	Nos	84		<ul style="list-style-type: none">• Informatory -square sign boards (Size of 300mmx300mm)	Nos	42		<ul style="list-style-type: none">• Warning /Cautionary -triangular sign boards (Size of 600mm)	Nos	189		<ul style="list-style-type: none">• Reflective road studs (Size of 50mmx100mmx102mm)	Nos	80,000	2	Signages at RLVD locations				<ul style="list-style-type: none">• Cautionary Square Sign boards (Size of 300mmx300mm)	Nos	177		<ul style="list-style-type: none">• Informatory Sign on Gantry Boards (Size of 9600mmx2600mm)	Nos	135	3	Signages at SLVD locations				<ul style="list-style-type: none">• Speed warning Square sign board (Size of 300mmX300mm)	Nos	11	4	Signages at TIDS locations				<ul style="list-style-type: none">• Cautionary -Square Sign board (Size of 300mmx300mm)	Nos	58	5	Signages at ATCC locations				<ul style="list-style-type: none">• Cautionary -Square sign board (Size of 300mmx300mm)	Nos	230	6	Road Markings				Road Markings such as Centre Line, Traffic Lane Lines, Border lines, Stop Line, Give Way Lines, Hazard Marking, Pedestrian Crossing, Directional Arrows, Word Messages, Turning Lane Road Marking, Bar Marking and hatch Markings	Sq M	1,75,000	7	Footpath and Median extension		
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	7	Footpath and Median extension																																																																						




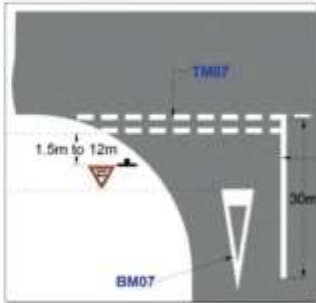
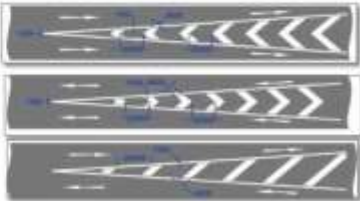
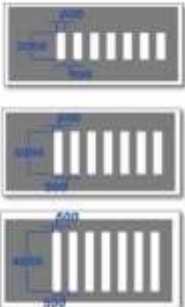
No.	Requirements			
		Footpath and median extension work as given in the reference drawing for 2-arm junction	Nos	3
		Footpath and median extension work as given in the reference drawing for 3-arm junction	Nos	71
		Footpath and median extension work as given in the reference drawing for 4-arm junction	Nos	88
		Footpath and median extension work as given in the reference drawing for 5-arm junction	Nos	3
	<p>The type and number of Road Signs, Marking, Footpath and median extension and other quantities given above are indicative and minimum in number, however during the detail design the Contractor is required to submit detailed design and detailed BOQ to Engineer for approval.</p> <p>The cost of the Road Signs and other materials that is not explicitly listed in the BOQ of the Bid submitted by the Bidder or supplied by the Bidder during the installation works but deemed necessary for the system during any stage of this Contract shall be included in the cost of appropriate items and the Contract Price, and no separate payment shall be made.</p> <ul style="list-style-type: none"> ■ The representation drawings are attached in the next page. 			




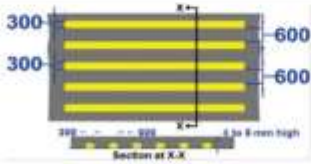

INTERSECTION DESIGN REPRESENTATION

Legend		
Item No.	Item	Specifications
1	Traffic Lane Lines	IRC 35 - Table 4.3 and Table 4.4
2	Centre line	
3	Border or Edge Lines	
4	Stop Line	IRC 35 - TM01
5	Giveway Line	IRC 35 - TM07
6		IRC 35 - BM07
7	Hazard Marking	IRC 35 - Table A.3
8	Pedestrian Crossing	IRC 35 - BM01, BM02, BM03
9	Directional Arrows	IRC 35 - AM01 to AM12
10	Word Messages	IRC 35 - DM01, DM02, DM15 to DM18
11	Turning Lane Flood Marking	IRC 35 - LM19
12	Halt Marking	IRC 35 - Table A.3
13	Border or Edge Lines	IRC 35 - Table 4.3 and Table 4.4
14	Bar Markings	IRC 35 - TM08
15	Footpath Extension	Footpath should be extended! Constructed as shown
16	Median Extension	Median should be extended! Constructed as shown
17	Give way	IRC 67 - Table 14.3
18	One way	IRC 67 - Table 14.4
19	U-turn Prohibited	
20	U-turn Allowed	IRC 67 - Table 17.1



Note: All dimensions are in mm

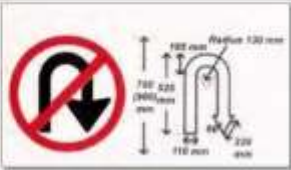

Road Markings:

S. No	Items	Sample Illustrations	Description	Specifications
1	Centre Lines		Centre line separates the opposing traffic and facilitates their movements in single carriageway roads. The centre line marking may be a single solid line (no overtaking lines), where overtaking is prohibited.	Lane markings as per Table 4.3 and Table 4.4 in IRC 35. Markings should be provided for 100meters in arterial roads and 60meters in sub-arterial roads from stop line.
2	Traffic Lane Lines		The carriageway having two or more lanes in one direction are divided into separate lanes by traffic lane line marking for vehicles to move in proper lanes. At intersection to prevent the unauthorised use of the right turn storage lane (which is exclusively meant for right turning traffic) by the through straight traffic, shall be converted to solid line which would serve as barrier line.	
3	Border or Edge Lines		The border or edge lines are intended to indicate end of the carriageways and thus help to delineate the limits up to which driver can safely venture.	
4	Stop Line		Stop line indicates the position beyond which the vehicles should not proceed when required to stop by control devices like signals.	Solid white transverse line as per IRC 35 - TM01
5	Give Way Lines		The Give way marking consists of two broken lines laid side by side. The Give way lines shall be supplemented by the hollow triangular Give Way approach marking and a Give Way roadside signs.	Give way lines as per IRC 35 - TM07 and BM07
6	Hazard Marking		Hazard markings (chevron and continuous) are utilized to demarcate the neutral area at the nose of a channelizing island and warning signs;	Hazard markings as per Table A.3 of Annexure A in IRC 35
7	Pedestrian crossing		Pedestrian crossing shall be provided at all intersections and is essential where conflict exists between vehicles and pedestrians.	Pedestrian crossing as per IRC 35 - BM01, BM02, BM03


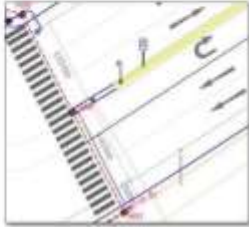
8	Directional arrows		Used to guide the drivers in advance over the correct lane to be taken while approaching intersections	Directional arrows as per IRC 35 - AM01 to AM12 as per reference drawing
9	Word Messages		Information to guide, regulate, or warn the road user may also be conveyed by inscription of word message on road surface	Word message sign marking as per IRC 35 - DM01, DM02, DM15 to DM18
10	Turning lane road marking		Guides the turning vehicles to travel in their lanes / routes	Turning lane marking to be done as per reference drawing. For marking IRC35 - LM19 to be followed.
11	Bar Markings		Thermoplastic bar marking is a softer treatment to reduce the speed; up to 50 kmph 1 set shall be used	Bar marking as per IRC 35 - TM08
12	Hatch Marking		For deflecting of one lane to other and also for achieving lane reduction situation, it shall be done with hatch markings	Hazard markings as per Table A.3 of Annexure A in IRC 35

Signages:

S. No	Items	Sample Illustrations	Description	Specifications
1	GIVE WAY		The GIVE WAY sign is used to assign right-of-way to traffic on certain roadways at intersections	Give Way signs as per Table 14.3 in IRC 67.
2	One Way		The sign shall be located at the entry to the one-way street. At signalized intersections, ONE WAY signs shall be placed either near the appropriate signal faces, on the poles holding the traffic signals, on the mast arm or span wire holding the signals.	One Way & U turn prohibited signs as per Table 14.4 in IRC 67.

3	U-turn Prohibited		The sign shall be used at the places where vehicles are forbidden to make a turn to reverse direction of travel between the sign and the next intersection beyond it.	
4	U-turn Ahead		The sign is positioned on the median in advance of a U-turn	U – turn Ahead sign as per chapter 17.1 in IRC 67.

Footpath and median works:

S. No	Items	Sample Illustrations	Description
1	Footpath		The footpath should be extended / constructed as shown in the reference drawings in blue color (e.g., Portion between Red line to blue line) needs to be extended and materials to be used as per existing one.
2	Median		The Median should be extended / constructed as shown in the reference drawings (e.g., Portion between Red line to blue line) needs to be extended and materials to be used as per existing one.

Chapter 2-4 Requirements of Traffic Incident Detection System

1 General

The Traffic Incident Detection System (TIDS) shall provide and construct to monitor the traffic incidents at each identified locations that meets the requirements stated herein. The Traffic Incident Detection System (TIDS) under this Project shall be installed at the merging points of grade separated roads (accident prone areas, and/or traffic congestion prone areas) in the City

Traffic Incident Detection System cameras (PTZ and Fixed) are planned to be installed on same pole will be used to monitor the status of traffic, road, and traffic incidents to enhance user safety through necessary decision-making process. The number of Traffic Incident Detection System (TIDS) to be installed is 58 Locations as given in this chapter for CITS Project.

Digital type system shall be used and video signal output from the camera shall be digitized and compressed to reduce the bandwidth requirement for digital transmission system. The system and its component devices shall be of rugged construction for outdoor industrial use capable of continuous operation. General requirements of the TIDS are described as follows.

- (a) TID (Fixed) cameras shall be installed with the capability of automatic traffic incident detection, and PTZ cameras for the detailed monitoring of the road situation, Congestion etc. especially when incidents happen and facilitate the decision-making process to the authorities from the Control Centre.
 - (b) PTZ camera shall be move and zoom in at incident location without manual intervention.
 - (c) PTZ & TID cameras shall have functionality to take images in night-time (Zero Lux) and connectivity with high-capacity communication network.
 - (d) PTZ cameras shall be equipped with zoom and pan-tilt functions to secure wider area and longer distance coverage.
 - (e) TID and PTZ camera devices shall be easily available in India.
 - (f) Traffic Incident Detection system (TIDS) shall be integrated and able to transmit the detected incident information to the Incident Management Module of the Integrated Traffic Management System (ITMS).
 - (g) TIDS shall be able to monitor the real-time images at the target locations.
 - (h) LPU shall have Live recording functionality at local level and accessible as and when required form Control Centre
-

2 System Configuration

The configuration of the TIDS is given in the diagram below.

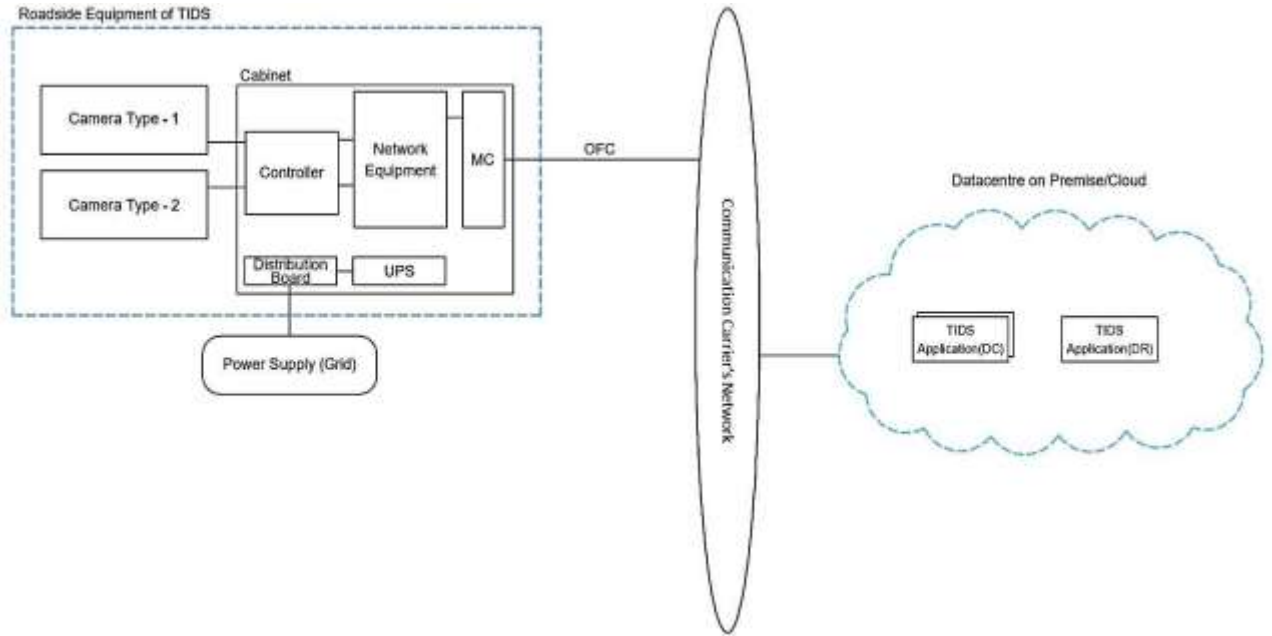


Figure 2-1: System Configuration of TIDS

3 Equipment Location and Type

The proposed locations for Traffic Incident Detection system (TIDS) are shown below in the Table. The Contractor shall adhere to the proposed locations as much as possible to satisfy the above requirement. In case of any changes in the locations the Contractor shall get the written approval from the Engineer based on the alignment, geometry, viewing area (based on site visit).

Table 3-1: Proposed Location of TIDS

No.	Latitude	Longitude	Location Description
1	13.0079975	80.2076051	SB Inner Ring Road merging with EB Anna Salai
2	13.0133295	80.2040201	Kathipara Grade Flyover Merging at NB Inner Ring Road
3	13.0074175	80.2016223	WB Anna Salai traffic merging with NB Chennai Trichy Highway traffic on Binny Road
4	13.0041510	80.2010811	IRR Alandur-Guindy to Airport merging.
5	12.9642916	80.1474319	Pallavaram Flyover merging on NB Chennai Trichy Highway
6	12.9577614	80.1439528	Pallavaram Bridge-Chromepet to Tambaram side merging.
7	12.9503483	80.1392870	MIT Flyover merging with NB Chennai Trichy Highway
8	12.9438780	80.1344886	MIT Flyover-Chromepet to Tambaram side merging.
9	12.9266608	80.1176801	Tambaram flyover merging with NB Chennai Trichy Highway

10	12.9203032	80.1114306	Tambaram Flyover- Chrompet to Tambaram side merging.
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No.	Latitude	Longitude	Location Description
11	12.9159324	80.1051381	Chennai Bypass road On-ramp merging with NB Trichy-Chennai Highway
12	12.9132553	80.1015076	Chennai-Trichy Highway merging on to Chennai Bypass road
13	12.8959305	80.0883332	Vandalur Flyover On-ramp merging with NB Trichy-Chennai Highway
14	12.8899281	80.0844949	On-ramp from Vandalur Flyover to Chennai-Trichy Road
15	12.8868647	80.0831831	On-ramp from Chennai Outer Ring Road to NB Chennai-Trichy Highway
16	12.8806137	80.0807637	Chennai Outer Ring Road Chennai-Trichy Highway merging
17	13.0762678	80.2022542	Koyambedu Kamaraj Flyover-Vellore to Chennai side merging. Near TATA Motors
18	13.0777007	80.1989252	NB Inner Ring Road merging with EB EVR Road,
19	13.0752387	80.1958994	Koyambedu Kamaraj Flyover-Chennai to Vellore side merging.
20	13.0736730	80.2004525	SB Inner Ring Road merging with WB EVR Road
21	13.0612995	80.1633334	Maduravoil Flyover-Chennai to Vellore side merging.
22	13.0615494	80.1588332	Maduravoil Flyover-Vellore to Chennai side merging.
23	13.0985097	80.1973102	Padi Crossing Flyover merging on SB Grand Northern Trunk Road
24	13.1031559	80.1989019	Padi Crossing Flyover-Chennai to Thiruvallur side merging.
25	13.1058269	80.1946626	Padi Crossing Flyover merging on NB Grand Northern Trunk Road
26	13.1012698	80.1900540	Padi Crossing Flyover-Thiruvallur to Chennai side merging.
27	13.1398353	80.2181348	Jawaharlal Flyover Merging with SB 200 ft. road
28	13.1496718	80.2222937	Jawaharlal Flyover Merging with NB 200 ft. road
29	13.1506944	80.2117778	Chennai Bypass road terminal with Chennai Kolkata Highway on SB side
30	13.1530966	80.2085256	Chennai Bypass road terminal with Chennai Kolkata Highway on NB side
31	13.0484431	80.0838906	Under ORR Flyover, Poonamalle
32	13.0878870	80.2614879	Purasaiwalkam Bridge merging on Hunters Road on EB side
33	13.0861686	80.2557883	Purasaiwalkam Bridge merging on Purasaiwalkam High Road on WB side
34	13.0677364	80.2550760	Pantheon road flyover merging on WB side near Cooptex Showroom
35	13.0715122	80.2590706	Pantheon road flyover merging on EB side near Egmore Hospital
36	13.0546894	80.2553011	Peters Road Flyover- Merging towards Marina Beach side. (Near The New College autonomous)
37	13.0542044	80.2608885	Peters Road Flyover- Merging towards Anna salai road. (Infront of Thousand light House)
38	13.0541952	80.2609542	Peters Road Flyover- Merging towards Marina Beach side.
39	13.0536428	80.2670231	Peters Road Flyover- Merging towards Anna salai road.
40	13.0539627	80.2532078	Gemini Flyover- towards Anna salai merging (Near Bajaj Auto -Subway)
41	13.0423188	80.2681122	Royapettah High road flyover- merging towards Mylapore

No.	Latitude	Longitude	Location Description
42	13.0466442	80.2663676	Royapettah High road flyover- merging towards Avvai Shanmugam Salai
43	13.0447989	80.2628451	Cathedral road flyover- merging towards Royapettah high road
44	13.0458875	80.2571102	Cathedral road flyover- merging towards Gemini flyover
45	13.0512631	80.2339132	SB Usman flyover merging with WB Arcot Road Traffic
46	13.0568421	80.2347996	NB Usman flyover merging with EB Arcot Road Traffic. Near Vijay Super Market
47	13.0436935	80.2377553	Gopathi Narayanaswami Chetty Road Bridge traffic merging with traffic from Dr. Nair road
48	13.0464962	80.2426970	Gopathi Narayanaswami Chetty Road Bridge traffic merging with traffic near New Giri Road
49	13.0366742	80.2307608	South side of Usman Road Flyover merging with traffic under bridge near Pothy/60+s Supermarket
50	13.0449009	80.2325115	North side of Usman Road Flyover merging with traffic under bridge near Vyasara street
51	13.0351166	80.2570552	TTK Flyover- merging towards CV Raman road
52	13.0274658	80.2446383	GK Moopanar flyover- merging towards Kotturpuram bridge
53	13.0319808	80.2458584	GK Moopanar flyover- merging towards mount road
54	13.0067002	80.2448155	East end of IIT Madras Flyover merging with the traffic
55	13.0110261	80.2172810	Guindy Flyover towards Anna Salai, Near to MGR Medical University
56	12.8737995	80.0779835	New Recommended Location, Ambika Nagar,Urapakkam
57	13.0761551	80.1990972	Under flyover SB Inner Ring Road merging with WB EVR Road
58	13.0613419	80.1610054	Under Maduravoil Flyover- Chennai to Vellore side merging.

4 System Functional Requirements

TIDS application shall have the minimum functional requirements as specified under this section. The Software shall provide a widely supported Relational Database Management System suitable for use in a client-server environment in support of transit system changes and expansion.

All physical and software protocols interface shall be designed based on international standards. The software package shall also include utilities necessary to perform various services required to maintain and configure the system software.

The TIDS application software shall be a set of software's to operate on the servers, operator consoles, terminal equipment, and other components and devices. The software shall function as a system to provide end results required to the user.

The software to be provided as TIDS application shall include the minimum requirement but not limited:

- Server/NVR application software (TIDS sub-system)
- TIDS control application software (TIDS sub-system)
- Traffic analysis processing software (Vehicle detection sub-system)
- Maintenance activity tracking and logging software

Traffic Incident detection system shall be designed as an on-line real-time system in which all TIDS devices in the system continuously operate and exchange data between the TIDS application and field equipment 24 hours a day and 7 days a week without shutdown. Thus, high reliability, availability and performance shall be achieved as envisaged in Service Level Agreement (SLA). No interruption of the system operation shall be allowed even for maintenance purpose. The TIDS software/Application shall be suitable for on-line real-time system. The software shall exhibit high reliability and operate without error under different conditions.

The system functional requirements of TIDS are specified below.

Table 4-1: Functional Requirement of TIDS

No.	Item	Requirements
1	Centralized management	The TIDS application shall be able to work as Management Client connected to the management server enables full remote system configuration of all recording servers, failover servers, devices, rules, schedules and user rights.
2	Alarm Manager	<ul style="list-style-type: none">■ TIDS central application shall be a single-point alarm function that provides a consolidated and clear overview of security and system-related alarms.■ Dedicated tab for the Alarm Manager shall be available in TIDS application.■ TIDS application shall have alarm list with extensive filtering capabilities and an alarm preview in both live and playback mode.■ Extensive alarm sort and filtering functions allow operators to focus on most critical alarms.■ Instant preview of primary and related TIDS cameras helps to reduce the number of false alarms.■ TIDS application shall have a tight integration with the GIS map function which allows operators to indicate and acknowledge active alarms on the map.■ Alarm descriptions and work instructions make alarms actionable for operators.■ Alarm escalation and alarm forwarding possibilities allow operators with appropriate skills to handle different alarms.■ TIDS application shall have alarm report enabled incident documentation.■ TIDS application shall have alarm location map which shows the operator a map of the alarm area when the alarm is selected.■ TIDS application shall have function of alarm notification to a single or a group of TIDS application users using Push Notifications.■ Optional sound notifications for different alarm priorities for notification of new incoming alarm.■ Alarm disabling option enables users to suppress alarms from a given device in a certain time period.■ Instant access to both live and recorded video from the cameras that are related to the alarm handling reports give valuable information about alarm inflow and alarm handling performance
3	Centralized Search for End user	<ul style="list-style-type: none">■ TIDS application shall be able to search recording sequences, bookmarks, events, motion, alarms, vehicle, people, location, and events. Save search templates. Visualize location of Search result.■ Dedicated tab for Centralized Search (replacing Sequence Explorer)■ Search categories are video sequences, bookmarks, motion, alarms and events, people, vehicle and location.■ Visualize location of Search result.■ Save search templates including camera list and time scope.■ Preview of selected search results with direct options for export of video, making bookmarks, exporting to pdf, and more formats.■ Hide/show search results that are not matched on all search agents.
4	Automatic Incident Detection	<p>The following items shall be detected by the system.</p> <ul style="list-style-type: none">■ Wrong-way Driving■ Stopped Vehicle■ Traffic Slowdown/Congestion■ Slow vehicle / Speed Drop■ Crowding Detection■ Pedestrian■ Collision /Accident■ Cattles /Animal

No.	Item	Requirements
		<ul style="list-style-type: none"> ■ Object Detection on the Road (Debris, Obstacles, etc.) ■ Camera Tampering ■ The number of detection zone in the image shall be greater than 90 Multi incident detection at a time at the LPU level.
5	Pan-tilt-zoom (PTZ) control	<ul style="list-style-type: none"> ■ The TIDS System shall be capable of remotely controlled function of pan, tilt and zoom for selected camera from the control center. Each camera should have a normal position of pre-set pan and tilt angles and a pre-set focal length to return and stay when the manual control of PTZ is released. ■ Application shall have a functionality for “Pass-through” control of manual PTZ operation from the Employer with user priority. ■ Application shall provide the levels of PTZ priority for control of rights between different operators and automatic patrolling schemes. ■ Execute rule-based go to pre-set position on events and patrolling ■ Pause PTZ patrolling on event and resume patrolling after manual session timeout ■ Import PTZ presets defined in the PTZ camera ■ Rename imported PTZ presets ■ Control PTZ cameras by using. ■ PTZ preset positions and PTZ point-and-click control ■ Overlay buttons ■ PTZ zoom to a defined rectangle and Video overlaid PTZ control ■ Virtual joystick function and with physical Joystick ■ Manage PTZ presets and View who have PTZ control and time to automatic release ■ Take manual control of a PTZ camera that is running a patrolling scheme. After a timeout with no activity, the camera reverts to its scheduled patrolling scheme
6	Metadata support & Storage	<ul style="list-style-type: none"> ■ Received images need to be automatically saved in storage devices of NVR including camera ID and respective time. The minimum storage time is 1 year. Besides, the status of camera is also saved at NVR. ■ All data transmitted from the TIDS equipment’s and processed data in the control center shall be recorded and stored in the NVR for analysis and future usage. Data retrieval and presentation software should be provided that can easily retrieve and show the movie image and still image of the specified TID at the hour or day. ■ Status of roadside equipment (normal or malfunctioned) should be recorded in the NVR as operation log and for future reliability analysis together with error code and time stamp. ■ TIDS application shall be able to supports reception, storage and export of metadata, including metadata from camera-resided video analytics and location data in Video Push from other sources. ■ TIDS application shall be able to support Edge Storage with audio, uses camera-based storage as a complement to the central storage in the recording servers, with flexible video retrieval based on time schedules, events or manual requests, including the ability to combine centrally and remotely stored video. ■ TIDS central application shall have data storage solution that combines superior performance and scalability with video data grooming for cost-efficient, long-term video storage, with the option to encrypt and digitally sign stored video and audio. ■ Definition of one or more storage containers with individual archiving schemes and retention times. Recording capacity is limited only by disk space ■ Each storage container is defined as live database and one optional archive, where the video data is moved from the live database to secondary disk systems or network drives. The archived data is still online and available

No.	Item	Requirements														
		<p>for clients</p> <ul style="list-style-type: none">■ Optional video data grooming possibility enables re-duction of video recording data size by reducing the frame rate of the video data■ Ability to allocate individual devices to different storage containers/disk. Move a device or a group of devices between two storage containers/disk.■ Light and strong video database encryption option, using AES256 encryption algorithm.■ Manage maximum recording time for manual recordings. <table><tr><td></td><th>Data</th><th>Data Type</th><th>Storage Time</th></tr><tr><td rowspan="3">TID System</td><td>TID Video</td><td>Raw Data</td><td>1 Year</td></tr><tr><td>TID Images</td><td>Raw Data</td><td>1 Year</td></tr><tr><td>Equipment Status</td><td>Raw Data</td><td>2 years</td></tr></table> <p>.</p>		Data	Data Type	Storage Time	TID System	TID Video	Raw Data	1 Year	TID Images	Raw Data	1 Year	Equipment Status	Raw Data	2 years
	Data	Data Type	Storage Time													
TID System	TID Video	Raw Data	1 Year													
	TID Images	Raw Data	1 Year													
	Equipment Status	Raw Data	2 years													
7	Image Recording and Retrieval and Recording servers	<ul style="list-style-type: none">■ All images should be automatically recorded in the storage device of the NVR with camera ID and time stamp. Frame rate of the video signal can be reduced to one frame per second to reduce the requirements for the storage capacity required. Images should be stored for a minimum 1 year. The TID still image together with equipment operational status should be also stored in the storage server of NVR■ TIDS shall be able to allow more cameras to be run on a single recording server using 64-bit recording server.														
8	Intuitive map function with Smart Map	<ul style="list-style-type: none">■ TIDS application shall be able to show a Schematic Road map of location. Map shall be Smart Map with intuitive map function with below give features:■ Multi-layered and interactive maps display the location of every camera and offer control of the entire surveillance system. It shall also have seamless drag-and-drop integration with Smart video Wall.■ Seamless geo-navigation supporting map services such as Bing, Google and Open Street Maps as well as georeferenced GIS maps and CAD drawings, with drilldown possibilities to the classic maps.■ Map images can be in standard graphic file formats including JPG, GIF, PNG and TIF■ Any number of layered maps such as city, street, roads■ Instant camera preview on “mouse over” and one-click shows all cameras on map.■ One-click function to open floating window with all cameras (minimum 30 cameras) on the map.■ Depiction of camera view zones on map with clickable PTZ zones for instant PTZ control.■ Easy drag-and-drop and point-and-click definition of: cameras, servers, microphones, speakers, I/O devices, hot-zones for map hierarchies, camera view zones and PTZ camera presets position view zones.■ Real-time status monitoring indication from all system components including cameras, I/O devices and system servers■ Graphical visualization of the system status through color coding.■ Hierarchical propagation of status indications to higher ordered maps.■ System performance data for cameras and servers including camera resolution, FPS, network use and disk space etc.■ Ability to suppress status indications (such as error and warning) for a given device.■ Possibility to edit device names in a map and assign map-specific names and references to devices in a map.■ Map editing subject to user rights■ Alarms on Smart Map														

No.	Item	Requirements
9	Evidence export	<ul style="list-style-type: none"> ■ TIDS central application shall be able to deliver authentic evidence to public authorities by exporting video and images to various formats, including video from multiple cameras in encrypted format with dedicated player application included.
10	Audit logs	<ul style="list-style-type: none"> ■ This TIDS application shall enables extensive logging of all user system accesses, configuration changes and operator actions.
11	Flexible user and rights management	<ul style="list-style-type: none"> ■ Application shall have strict privileges on management of users' access to functions and camera actions.
12	Versatile rule system	<ul style="list-style-type: none"> ■ TIDS application shall have a Facilities for the automation of different aspects of the system, including camera control, system behavior and external devices, based on events or time schedules.
13	System Monitor	<ul style="list-style-type: none"> ■ Application shall have a customizable real-time system monitoring dashboard and report function for proactive maintenance of the Video Management Software installation. ■ The road and traffic conditions images are taken by TID cameras on the merging points is transmitted as video signal to the NVR/sever at the TIDS Command Control Centre through the communication network. ■ The TID center controller via the NVR can select video signal from any TID camera to be displayed on the display monitor and video wall of the TID center controller console and monitor screens. ■ Sequential display function is provided to the TID System. The sequential display function allows the video image from the multiple cameras to be sequentially displayed at a pre-set interval. It should be possible to select the cameras for sequential display and to set the display time of the image from each camera. ■ Character generating function Should be provided to the TID central equipment to superimpose camera location name over the video image. ■ The TID display monitor on the console and monitor screens Should have 03-screen capabilities and Should display either one image or four images at a time. The image on the monitor screens can be controlled by the TID center controller console.
14	Integration options	<ul style="list-style-type: none"> ■ The TIDS application Integration Platform shall be Software Development Kit (MIP SDK) enables seamless integration of video analytics algorithms and other third-party applications. ■ The TIDS application shall be compatible with any LPR for automatic reading and tracking of vehicle license plates ■ The TIDS application shall be able to supports ONVIF Bridge that enables full video interoperability in multivendor installations using a standardized ONVIF compliant video-out interface. ■ Supports display of MIP SDK plug-in items on the Smart Map ■ The TIDS application shall be able to enables integrations to third party Mobile or Web applications. ■ Application's Driver Framework enables device manufacturers to develop their own drivers for TIDS application using their SDK.
15	Client access	<ul style="list-style-type: none"> ■ Application shall be full accessible by the clients. And client will have access for authenticated and authorized at the management server and use a session-limited access token to access the recording server ■ System administrators controlling systems with multiple users can control access permission
16	Alerting and notification	<ul style="list-style-type: none"> ■ System shall be able to show live health status of each field component, sup components in control center and system shall be able to generate alert and display in the control room for following status but not limited: <ul style="list-style-type: none"> a. Power status (Law power, UPS), b. Low battery alert,

No.	Item	Requirements
		<ul style="list-style-type: none"> c. Cabinet door Open, Close d. Connectivity status e. Temperature status f. Camera status g. LPU alert etc.
17	Logs	<p>TIDS application shall show logging of system, audit and rule entries to the management server with local caching during offline scenarios.</p> <ul style="list-style-type: none"> ■ Logs of system, audit and rule entries are consolidated from all recording servers and clients. ■ Each log file has adjustable size and time limitations
18	User rights management	<ul style="list-style-type: none"> ■ Common and central management of all user rights across all user and programmatic (SDK) interfaces. ■ Overall system security definition makes it possible to globally allow or deny permission to devices and functions (such as manage, read, edit, and delete). ■ Device-specific security definition makes it possible to allow or deny permission to individual devices and functions (such as manage, read, edit, and delete). <p>Roles control user and administrator access to:</p> <ul style="list-style-type: none"> ■ General: user profile Management, dual authorization rights, system log-in time profile. ■ Cameras: visibility, administrate, live view (within time profile), playback (within time profile), search sequences, export, smart search, AUX commands, manual recording, bookmark functions ■ Microphones and speakers: visibility, administrate, listen to live audio (within time profile), playback audio (within time profile), search sequences, export, manual recording, bookmark functions, speak to speakers ■ Inputs and outputs: visibility, administrate, status, activation ■ PTZ: manual control, activate PTZ presets, PTZ priority, manage PTZ presets and patrolling, lock/unlock PTZ presets, reserve and release PTZ session ■ Remote recordings: retrieve remote recordings ■ Smart Video Wall: visibility, administrate, control, playback ■ External events: visibility, administrate, trigger ■ Alarms: visibility of alarms and ability to manage alarms
19	Web Client	<ul style="list-style-type: none"> ■ TIDS application shall have views through the browser and avoid advanced setup. ■ Application shared views can be managed centrally via the server with administrator/user rights and user groups ■ In live mode Adaptive streaming enables a lower resolution stream from the recording server to the Web Client when a high resolution is not required. ■ Direct streaming supported meaning that the Web client can receive H.264 directly from the recording server without transcoding which is more efficient and provides a smoother experience. ■ TID Camera search function promptly finds cameras, types of cameras and camera views in the system. ■ Easy single/multi camera video playback including fast/slow playback, single frame step and jump to date/time with frame preview while adjusting time. ■ Users can quickly get an overview and act if needed via the list of alarms. ■ Application shall have function with ability to save exports for later usage or download ■ Control PTZ cameras remotely with PTZ mouse gestures, including preset positions ■ Two-way audio support for playing and exporting live or recorded audio

No.	Item	Requirements
		<p>from device or camera-connected microphones. Use the camera's speaker to talk with a person in front of the camera, and at a later stage play back recorded audio</p> <ul style="list-style-type: none"> ■ Dynamic bandwidth optimization when streaming from server to client gives better use of bandwidth ■ Create AVI, MKV or database export. ■ Support for two-step verification for log-in ■ Secure connection through HTTPS ■ No installation needed on client computer.
20	System administration and Authentication	<ul style="list-style-type: none"> ■ Application shall have built-in backup and restore support for manual system backup of all configuration data, including system configuration data, maps, alarm settings and definitions and client views ■ System monitor with customizable dashboard for task or component specific live monitoring ■ Customizable Normal, Warning and Critical system monitor and event triggers for; CPU and Memory usage on servers, used space, recording and live FPS on cameras, free space on disks and predicated retention time for storage definitions ■ Configuration Reporting enables complete or partial documentation of system configuration. Custom and site-specific free-text information, integrator's notes and logo can be added to the printer-friendly reports ■ Dual authorization required an optional additional level of system security, where Management Client users are granted access to the system only when a second user or supervisor has confirmed the log-in with a successful authorization of the second user
21	Live view	<ul style="list-style-type: none"> ■ Application shall be able to show live video from 1-100 cameras per computer monitor/view at a time. ■ Application shall have a functionality to support a main window and any number of either floating windows or full screen views for Multiple computer screen or video wall. ■ Live view digital zoom allows a full view of recordings while the operator can digitally zoom in to see details ■ Adaptive streaming enables a lower resolution stream from the recording server to the Client/video Wall when a high resolution is not required. ■ Supports multiple view layouts optimized for 4:3 and 16:9 display settings in both landscape and portrait ■ Independent playback capability allows for instant playback of recorded video for one or more cameras, while in live mode ■ Centralized storage of shared and private camera views, enables coherent access to views across the system ■ Possibility to instantly rearrange cameras in views for optimized monitoring of incidents, with single click restore of original view. ■ Instant camera placement in live view allows for instant replacement of cameras in a view, where new cameras can be placed in a particular view and positioned through a simple drag and drop operation. ■ Global hotspot function allows users to work in detail with any camera selected from any view ■ Local hotspot function allows users to work in detail with a camera selected from the same view ■ A function required to make a specific view item rotate between pre-defined cameras that are not necessarily present in the view at the same time. Operators can select default or custom display times for each camera, and they are able to manually switch to the next or previous camera in the carousel list ■ Matrix function shows live video from multiple cameras in any view layout with customizable rotation paths, remotely controlled by computers sending

No.	Item	Requirements
		<p>matrix remote commands</p> <ul style="list-style-type: none"> ■ The operator can assign outputs, PTZ presets and views as actions to joystick buttons and as keyboard shortcuts.
22	Smart Video Wall	<ul style="list-style-type: none"> ■ Hardware independent, it runs on standard servers and displays. No special video wall hardware or network configurations required. ■ Flexible and scalable, it supports multiple video walls with an unlimited number and combination of monitors at any location. ■ Management of TIDS application for video Wall is fully integrated with the Management Client ■ Application of TIDS shall be able to provide presets powerful control of the layout (camera grid) and camera content ■ All user actions are subject to the assignment of user rights
23	Video Analysis Software Features	<p>The TIDS detection shall be robust to weather changes, lighting changes, tree swaying and other background distractions. Software shall be able to work well in crowding conditions. Software shall support object classification, Object Detection and shall be highly effective for the Classification of objects. The software is easy to install and simple to use with intuitive GUI. The TIDS software shall supports customization through variation of features for specific applications.</p> <p>The TIDS software shall supports distributed architecture. Following shall be the minimum features and options supported required in TIDS software application.</p> <ul style="list-style-type: none"> ■ Supports both native Windows UI and Web UI ■ Live View option for video wall and Live Reporting options ■ Administrator Login ■ Scheduler to enable scheduling of Analytics ■ Failover server ■ ONVIF streaming of analytics overlaid video, video stabilization ■ Alarm video creation and Snapshot creation ■ Alarms filters based on object properties – time, type, color, size, speed & aspect ratio ■ False Alarm Minimization with Deep Learning ■ Direct Camera Connection ■ Supports video analytics configuration on locked pre-set of PTZ camera ■ Option to run the Application as a Windows Service ■ People/Object/Vehicle counting report generation ■ Auto Emailer & FTP upload options for reports ■ Save, Export and Restore options for Analytics Settings of each Camera ■ Metadata Storage & Search for object's Type, Time, Color, Size, Speed and Aspect Ratio ■ Logical operation on Alarms ■ Both Server based and Edge based (on camera) analytics capabilities ■ Multi-region Analytics on a single frame (alerts for multiple features/regions simultaneously) ■ Options for Naming & Priority Settings for the regions. ■ Provides real time alarm snapshot and video. ■ View / Search / Reporting & Analysis options for video analytics alarms ■ Options for alarm Pop-up, Preview, Playback, Thumbnail view & Video Summary ■ Provides search capability for Forensic Search based on metadata / object properties. ■ Analysis tools for operations management: Heat Map, Motion Map, Flow Map. ■ Reporting in pdf, jpeg, excel, text file and scheduling reports for email & FTP. ■ Provides comparison reports for time series analysis. ■ Multi Camera Tracking & Camera Mapping

No.	Item	Requirements
24	Others	<ul style="list-style-type: none"> All the analytic features shall be executed at the LPU level and shall not affect any communication interruption with Server

Table 4-2: Functional Requirement of LPU (Local Processing Unit)

No.	Item	Requirements
1	Data Recording	If the connectivity to Control Center is not established, then all data pertain to the incidents shall be stored at least 7 days on site and will be transferred once the connectivity is re-established automatically. If when the data storage reaches capacity, the image processor shall automatically over-write the oldest data. The Contractor shall make the provision for no data loss.

5 Hardware Requirements

All hardware equipment shall as a minimum, meet all the requirements listed in the specifications. The equipment's provided shall accommodate to future technological advances which exceeds the minimum requirements provided in the specifications.

5.1 Camera Type 1 -TIDS Camera (Fixed Camera)

Table 5-1: Hardware Requirement of Camera Type 1 -TIDS Camera

No.	Item	Requirements
1.	Imaging Device	1/4-inch CCD/CMOS or better
2.	Video Resolution	VGA or better
3.	Frame Rate	Min. 25fps
4.	Scanning area	4.8 mm (H) x 3.6 mm (V)
5.	Scanning method	Progressive
6.	Minimum Illuminance	0.3 lx (colour), 0.1 lx (white/black mode)
7.	Video S/N ratio	50 dB or more
8.	Compression system	JPEG, MPEG-4, H.264
9.	Protocol	TCP/IP, UDP/IP, HTTP, RTP, FTP, SMTP, SNMP
10.	LAN terminal	10 BASE-T/100BASE-TX (RJ-45)
11.	Power Requirements	12 V \pm 10% DC
12.	Power Consumption	100 VA or less
13.	Environmental conditions	0 - 50 degree Celsius
14.	Reliability and maintainability	MTBF: 30,000 hours MTTF: 1.0 hour

5.2 Camera Type 2- PTZ Camera

Table 5-2: Hardware Requirement of Camera Type 2 -PTZ Camera

No.	Item	Requirements
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1.	Imaging Device	1/4-inch CCD / CMOS or better
2.	Video Resolution	1920 x 1080 or better
3.	Scanning area	4.8 mm (H) x 3.6 mm (V)
4.	Scanning method	Progressive
6.	Minimum Illuminance	0.3 lx (colour), 0.1 lx (white/black mode)
7.	Video S/N ratio	50 dB or more
8.	Pan driving range	360-degree endless turning, maximum speed 120 deg./sec more
9.	Tilt driving range	+5 (upward) to -90 (downward) degree, maximum speed 120 deg./sec
10.	Compression system	JPEG, MPEG-4, H.264
11.	Image size	640×480 (VGA) or higher
12.	Protocol	TCP/IP, UDP/IP, HTTP, RTP, FTP, SMTP, SNMP
13.	LAN terminal	10 BASE-T/100BASE-TX (RJ-45)
14.	Power Requirements	12 V ±10% DC
16.	Power Consumption	100 VA or less
17.	Environmental conditions	0 - 50 degree Celsius
18.	Reliability and maintainability	MTBF: 30,000 hours MTTF: 1.0 hour
19.	Zoom Lenz	30 x zoom and autofocus lens
20.	Lens Type	Optical 30 x/ digital 10 x or more
21.	Zoom Factor	3.8 to 114 mm or longer
22.	Focal length	Auto
23.	Iris	30 x zoom and autofocus lens

5.3 Controller -LPU (Local Processing Unit)

Table 5-3: Hardware Requirement of Controller-LPU

No.	Item	Specification
1.	CPU	Industrial or better
2.	Memory	2 GB DDR2/DDR3 RAM better
3.	Storage	minimum 1 TB SSD
4.	Network Adapter (NIC).	100 / 1000 base-t
5.	Others	The processor should be fan less type rated up to 70°

5.4 Network Infrastructure

The Contractor shall supply and install network equipment at each location to connect each peripheral to the system. The Bidder shall supply and install all equipment, cables, connectors, terminals and other miscellaneous materials necessary to establish a working local area network

connecting these systems.

The network between the Control Centre and sub-systems shall either use the optical fibre cable network or high-end Wireless Access Points along the Project Area and a data communication network shall be established using layered switches to be supplied by the Contractor.

The type and the number of the network equipment proposed by the Bidder as per the network design shall be mentioned by the Bidder in the BOQ. The network configuration shall be determined by the Bidder. The cost of the network devices and materials that is not explicitly listed in the BOQ of the Bid submitted by the Bidder or supplied by the Bidder during the installation works but deemed necessary for the system during any stage of this Contract shall be included in the cost of appropriate items and the Contract Price, and no separate payment shall be made.

5.5 Industrial Grade Layer -2 Switch

Table 5-4: Hardware requirement of Industrial grade Layer-2 switch

No.	Item	Requirements
1	Ethernet Interfaces	4 x 10/100/1000 Base-T PoE+ Ports auto-negotiation Plus 4 x 1000 Base-X SFP Uplink Slots (Should be loaded with 2 x 1G Single mode Industrial Grade Fiber Modules supports up to 10 Km)
2	Performance	Switching fabric 16 Gbps or more
		Forwarding rate 11.8 Mpps or more
3	PoE Budget	120 Watts
4	VLANS	512
5	Level 2 switching	IEEE 802.1, 802.3 standards, NTP, UDLD, LLDP, Unicast MAC filter, LACP, Private VLAN, Voice VLAN, VLAN double tagging (QinQ), STP, RSTP, MSTP, GARP, GMRP, GVRP, SNMPv1/v2c/v3, SNMP Inform, DHCP Server/Relay/Client, DHCP Option 66/67/82, BootP, RARP, TFTP, RMON, HTTP, HTTPS, Syslog, MRP (Client), LLDP, 802.1x, NetFlow/sFlow, port mirroring, Digital Diagnostic Monitoring (DDM)
6	Quality of Service (QoS)	Rate limit, auto QoS, ingress policing, egress queuing, and shaping
7	Multicast	IGMPv1, v2, v3 snooping, IGMP filtering, IGMP querier, MLD snooping v1, v2
8	Management	ICMP, Telnet, SSH, ARP, Syslog, SNMPv1/v2, RMON, SMTP, HTTP, HTTPS IPv4, IPv6
9	Security	Port security, 802.1x, Dynamic VLAN assignment, Dynamic Host Configuration Protocol (DHCP) snooping, dynamic ARP inspection, IP Source Guard, storm control - unicast, multicast, broadcast, SSH, SNMPv3, TACACS+
10	Power Input Voltage	12 to 56 VDC with Redundant dual power inputs with 5-PIN Lockable Terminal Block
		Reverse Polarity Protection
11	Warranty	Min 5 years
12	Power Supply	Bidder should provide Industrial Grade AC/DC DIN RAIL power supply.

5.6 SFP Transceiver

Table 5-5: Hardware requirement of SFP Transceiver

No	Item	Requirements
1	Media Type	Single-Mode or compatible with operator's network to be surveyed by bidder
2	Data Rate	1250 (Mbps)
3	Grade	Industrial

5.7 Din Rail Power Supply

Table 5-6: Hardware requirement of Din rail power supply

No	Item	Requirements
1	Input Voltage	180~240VAC
2	Input Frequency	50~60Hz
3	Output DC Voltage	48VDC±10%
4	Rated Current	2.5Amp
5	Current Range	0 ~ 5Amp
6	Rated Power	120W
7	Voltage Range	48~53VDC
8	Over-Voltage Protection	55~60VDC
9	Mounting Style	DIN Rail
10	Warranty	2 Years
11	Grade	Industrial

5.8 Power Supply and Outdoor UPS

Power supply and UPS shall be provided at each TIDS location. The Bidder shall present the calculation of power consumption and capacity of power supply system to be used for the TIDS system. The Bidder shall also consider the power requirement of network devices, wireless access points, switch, etc. suitably during the calculation. Proper earthing shall be provided at each equipment location.

The type and the number of the Power supply, Electric Meter proposed by the Bidder as per the design shall be mentioned by the Bidder in the BOQ. The cost of the Power Supply devices and materials that is not explicitly listed in the BOQ of the Bid submitted by the Bidder or supplied by the Bidder during the installation works but deemed necessary for the system during any stage of this Contract shall be included in the cost of appropriate items and the Contract Price, and no separate payment shall be made.

Table 5-7: Hardware Requirement of Outdoor UPS

No.	Item	Requirements
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1.	Input / Output Voltage	<ul style="list-style-type: none"> ■ AC 230 V / 50 Hz basically. ■ Output voltage: AC230V/50Hz ■ Commercial Power generally but with existing condition of power failure, instantaneous power failure and voltage fluctuation
2	UPS	<ul style="list-style-type: none"> ■ The UPS shall be of True online with double conversion topology. ■ The UPS shall work in outdoor environment to ensure all equipment's getting necessary power supply. No power surge.

	<ul style="list-style-type: none"> ■ The UPS unit shall have load level indicators that display the approximate electrical load placed upon the UPS. The UPS unit shall have a row of battery level indicators that display the approximate battery capacity. ■ The UPS unit shall have a minimum of the following as per OEM standard indicators: <ul style="list-style-type: none"> ➢ UPS Mode: On-line, Backup/Battery and Bypass; ➢ Over Load Indicator: This will display when UPS is running on overload; ➢ Battery Status Indicator: This will illuminate when battery is low or faulty/disconnected; and ➢ System Fault: This will illuminate when there is some fault or interruption in UPS. ■ The UPS unit shall include Ethernet communication port to support remote management and monitoring capabilities using SNMP including alarm contacts and remote shutdown. Remote monitoring and testing software shall be included. The manufacturer shall provide all SNMP traps. ■ The UPS unit shall include automatic restart. Upon restoration of utility AC power after complete battery discharge, the UPS shall automatically restart and resume operation. ■ The UPS unit shall be compliant to IEC 62040-1, CE, IEC602040-2 safety standards. ■ The UPS and batteries shall be mounted in a separate cabinet & the enclosure shall be under lock & key, utilising the minimum possible space and arranged in an aesthetic manner. ■ Any field UPS system (as per MSI's design) shall be supplied with an environmentally rated cabinet for installation of the UPS and batteries. The cabinet shall have a rating of IP 55. The cabinet shall be supplied with in-built fans and proper ventilation as needed to ensure that the temperature inside the cabinet does not exceed 40 degrees C at any given point in time. ■ Backup time at least 3 hrs or more
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5.9 Cabinets

Table 5-8: Hardware Requirement of Cabinets

No.	Requirements
1.	<ul style="list-style-type: none"> ■ The cabinet shall be electrically and mechanically robust and shall have a degree of protection of IP65 or higher specified in "IEC60529 Degrees of Protection Provided by Enclosures (IP Code)". ■ The cabinet shall have the provision for temperature controlling for optimal performance of equipment. ■ A right hinged door shall be provided on the front to realize easy maintenance work. The turning direction of the handle shall be counterclockwise. ■ The power supply including UPS shall be provided with a circuit breaker. ■ The anti-lightning and surge protection complying with the IEC61643-1 shall be provided. ■ Protection under/overvoltage condition shall be provided. ■ Monitoring status of temperature, battery and power supply ■ The cabinet shall be finished with the anticorrosive treatment ■ An internal lighting system ■ 220VAC plugs protected by a differential circuit breaker ■ An intercom jack

	<ul style="list-style-type: none"> ■ A file holder for the documentation ■ Standard key locks ■ Fixed on metallic cabinet frames (when false floor)
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5.10 Pole

Table 5-9: Hardware Requirement of Pole

No.	Requirements
1.	<ul style="list-style-type: none"> ■ The Contractor shall conduct the detailed design for the pole based on his site survey. ■ The Contractor shall conduct the appropriate measure for preventing the vibration which will affect the detection accuracy. ■ All components of poles may be hot dip galvanized, all components must be well protected against corrosion, minimum thickness of zinc coatings is 85 μ m and min density 500 gm/m² on both inside and outside surfaces ■ Certified BS EN 10025-4:2019 – TC ■ Required Lighting arrester arrangement inside the pole. ■ The poles shall incorporate suitably designed holes on the sides to allow for electrical cables to enter or exit the pole undamaged. ■ The bottom portion of the pole shall be treated for corrosion resistance in accordance to the installation site. ■ The structural design shall conform to relevant standards and shall be certified by a statutory authority for structural integrity and maximum allowable vibration (typically caused by Wind forces and other external stimuli) to ensure a stable image at full optical zoom of the camera mounted on it. ■ An access door at the bottom of the pole shall be provided at a typical height from the base for the termination panel. The access door shall of sliding type, top to bottom direction, so that it reams closed when even the clamp /hook to hold it is removed. The sliding rail shall be welded inside the pole. ■ Deflection due to wind shall not exceed 0.1 degrees at a wind speed of at least 28m/s with the equipment mounted on the pole. Suitably sized powder coated terminal box and terminal block assembly shall be provided and be treated as a part of the fixed pole. It shall be installed on the pole near the bottom end and the joint, cable entry/exit points (or glands) shall be sealed using a waterproof sealant to avoid water ingress into the box or the pole base.

6 Communication Requirements

Table 6-1: Communication Requirements of TIDS

No.	Requirements
1.	<ul style="list-style-type: none"> ■ Communication between the roadside equipment of TIDS and the TIDS server at Chennai Traffic Information and Management shall be wired connectivity provided by a single communication company. If required MPLS VPN to be provided ■ The required bandwidth for TIDS to ensure the stable communication connectivity shall be proposed by the Contractor and subsequently approved by the Engineer.

7 Installation Requirement

The minimum installation requirement of the TID camera and the PTZ Camera is as follows:

Table 7-1: Installation Requirements of TIDS

No.	Requirements
1.	<ul style="list-style-type: none"> ■ TIDS camera shall be mounted on a pole installed beside the roads on the shoulder or median as specified in the reference drawing for the TIDS. Height of camera shall be from 8 to 12 meters as indicated in the reference drawing, however the exact height of camera and Pole shall be based on the site requirement and approval from the Engineer. Pole shall be rigid enough so as not to vibrate under strong wind and passage of heavy vehicle. Optical fiber cable and power cable shall be extended from the nearest hand-hole at the shoulder where branch connection of cable is possible. The TIDS camera shall be connected to the nearest Wireless Access-point through repeater / access point / transceiver appropriately ■ The necessary safety measures, signages, barricading shall be provided ■ The Contractor shall make the provision for necessary civil, earthing, necessary cable conducting, manhole, Power supply, communication, new meter connection, quality, safety and last mile connectivity etc. to meet the functional requirement intended for the system with best industry practices. ■ The Contractor shall obtain necessary permission from respective agency. ■ The camera device with soft encoder will be basically put on the top of a supporting pole. The length of supporting structure should be of 12 meter or more to keep good visibility. ■ The TID camera and the PTZ Camera must be placed at the location where visibilities to both bounds on the road are kept as much as possible. In case any obstacles such as branches are identified at surrounding areas of TID location, such obstacles will be removed in advance of equipment installation. ■ The supporting pipe must be equipped with steel ladder to ease the maintenance work of TID camera and PTZ Camera. ■ The communication unit, camera control unit, power supply facilities and other devices installed at roadside will be housed in the cabinet. The cabinet would be hanging on the supporting pole. ■ The ground mounted enclosure shall be installed according to appropriate good engineering practices. All internal components and UPS (if required) shall be securely mounted. ■ For ground mounted enclosure installation, UV-resistant caulking material shall be applied along the joints of the enclosure. For mounting under a camera lowering system, the enclosure shall be positioned away from the space directly below related camera. ■ Provisions shall be made for all ducts (i.e., power, telecommunications, etc.), in accordance with the design drawings and/or specifications, that will facilitate the connection between the enclosure and the TIDS equipment. ■ Where cables enter the ground mounted enclosure, they shall be fixed and secured against movement and to relieve stress on the cable termination. All penetrations to the enclosure shall be sealed with silicone sealant to impede entry of gas, dust and water. ■ e. All wires/cables within the enclosure shall be secured and labelled. Earth wires from all electrical devices, including surge suppressors, shall be terminated directly to the dedicated earth terminal in the enclosure. Earth conductors shall not be daisy-chained from device to device.

1 General

VMS boards will be installed at locations on the upstream from the main radial and ring road junctions, for road users to display the alternative route.

The VMS System provides traffic information to the road users such as congestion level, expected travel time to reach the major destinations, and traffic message of accident, road work, road closure, etc. It aims to enable them to select the alternative route or encourage them to change their travel plan, by notifying such information in advance. The VMS boards will be installed at locations before reaching major junctions of the arterial roads where drivers are able to decide between the routes.

The number of VMS boards to be installed under this project is 17 units.

The general requirements of the VMS system are described as follows:

- (a) Receiving the traffic information generated by Traffic Information and Management System (TIMS).
- (b) Providing the received traffic information through VMS boards to the road users.
- (c) Providing the messages on the message line of VMS boards which are manually or semi-automatic inputted by the operators at the console terminal, to provide the information of traffic status, incident, road work and weather conditions on the road to the drivers/users in the city.
- (d) Providing the Traffic status on the simple schematic map of VMS boards which are real time transmitted from TIMS.
- (e) To provide option of alternative route selection to driver in the case of congestion and incidents on the road in the city.
- (f) To control the VMS at the Control Centre, where all information related to traffic, incident and weather conditions are collected, to provide the information with timely manner.
- (g) Storing the data on the provided messages for a certain period.
- (h) Monitoring the operation status of the equipment and system.

2 System Configuration

The scope/configuration of the VMS system is show in the figure below.

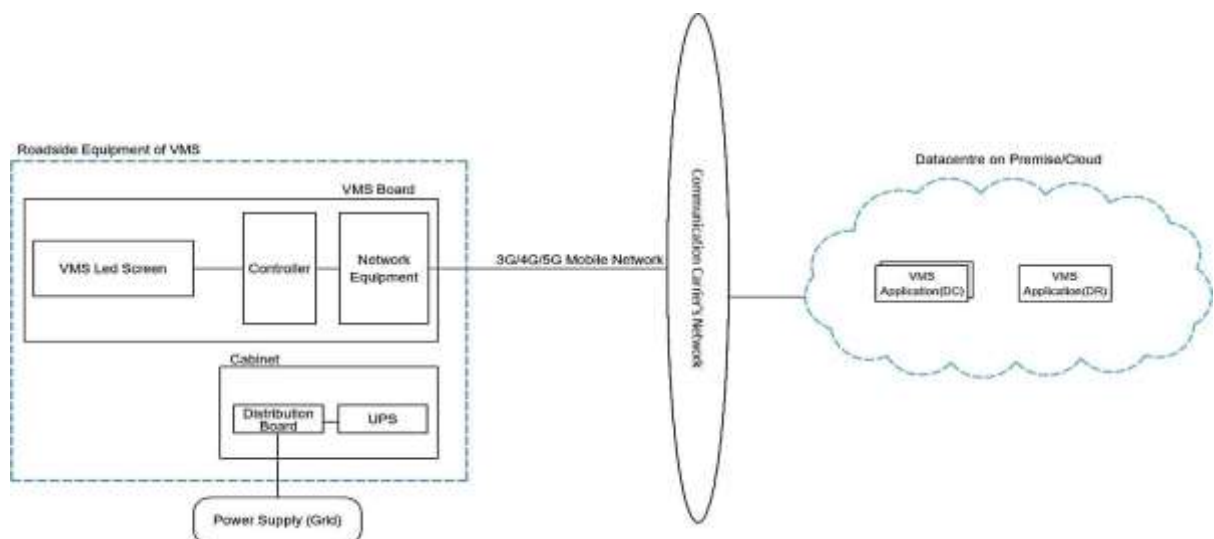


Figure 2-1: System Configuration of VMS

3 Equipment Location and Type

The proposed locations for Variable Message Sign (VMS) are shown below in the Table below. The Contractor shall adhere to the proposed locations as much as possible to satisfy the above requirements. In case of any changes in the locations the Contractor shall get the written approval from the Engineer based on the alignment, geometry, viewing area (based on site visit).

Table 3-1: Target Locations of VMS

No.	Latitude	Longitude	Location Description
1	12.873281	80.0777421	NB Chennai Trichy Highway junction with Chennai Outer Ring Road, Near to Buhari Hotel
2	12.908358	80.0976320	NB Chennai Trichy Highway junction with Chennai Bypass Road
3	13.001995	80.196409	Near Cantonment Board (St. Thomas Mount Head Post Office) Alanthur
4	13.077589	80.2806527	Anna Salai Road towards city
5	13.047566	80.0811848	NH-04 From CPRR towards ORR Junction
6	13.061491	80.157169	NH-04 From ORR towards Madhuravoil Flyover
7	13.074251	80.193136	NH-04 From Bypass towards Koyambedu Kamaraj Flyover, Near Chennai Metro office
8	13.081551	80.2741040	EVR Road- Near Central Junction towards city
9	13.124501	80.0511566	NH-205 From Thiruvallur towards ORR junction.
10	13.102579	80.158706	NH-205 From Avadi towards Ambattur Flyover Junction,
11	13.100538	80.188720	NH-205 From Bypass towards Padi crossing flyover, Near to Sundram Fasteners Limited
12	13.216360	80.169684	SB Chennai Srikakulam Highway junction with Chennai Outer Ring Road, Near Nallur Toll Plaza
13	13.161950	80.2029683	Near Puzhal Central Jail
14	13.148607	80.2145770	Chennai- Srikakulam Highway, Retteri Lake, Madhavaram.
15	13.178923	80.270100	Junction of NB State Highway 104 with IRR
16	13.186021	80.2698679	Junction of SB State Highway 104 with IRR
17	12.990125	80.2507408	SB Rajiv Gandhi IT Expressway junction with ECR. Location- in front of Tidal Park entrance.


4 System Functional Requirement

The use of VMS will be, in most cases, coordinated from a CCC, where a control system will be used to control and monitor the VMS used. In this project 17 number of VMS will be used, so this will be very important that the operator should have a clear overview of all messages displayed. The user interface should also help the operator in setting up, changing, and cancelling the messages.

Some messages should be automatically displayed, without the intervention of an operator; for instance, congested level and travel time indications based on automatically obtained traffic data. Some other messages should be planned beforehand, for instance in case of road works or pre-announcements. In those cases, the rules of this guideline should be applied “off-line”, and long before they are used. But some other messages, like those related to sudden incidents or weather circumstances, need a quick reaction from a traffic operator. This means traffic operators need to be trained in using the basic principles of the guideline.

CCC should have a reliable logging of all messages displayed, in order to be able to show exactly what was displayed when and where, in case authorities might want to investigate incidents or complaints.

Table 4-1: Functional Requirement of VMS

No.	Requirements
Message Display Functions	
1	<p>Message to be displayed on the VMS shall be concise and clear as the road users have to read and understand the message in a short time. Messages shall have uniform structure and simple words shall be used. In principle, a message to be displayed on the VMS board shall be composed of three parts, “location”, “event”, and “action” to be taken by the road users. The graphic type VMS shall be multi-color type for better presentation of contents.</p> <p>(1) Location Location indicates the relationship between the VMS location and the incident location. They can be expressed as section (between junction A to junction B), distance (ahead, xx km ahead), or specific location (near junction A).</p> <p>(2) Event Event is a thing that has happened or taken place on the road. It includes traffic conditions (accident, congestion), traffic regulation (lane closure, road maintenance work), road condition (wet road surface, damaged pavement), and weather condition (fog, rain, strong wind and flood).</p> <p>(3) Action The action is to be taken by the road users such as “slow down”, “cautious” and “use right/left lane”.</p>
2	<ul style="list-style-type: none"> ■ All the three components are not necessarily required all the time. Messages consisting of one or two components described above or simple message shall also be displayed. ■ The variable message sign system shall be capable of displaying the graphic symbol marks. It is also able to display other information such as incidents and/or time to destination. ■ The sample symbol marks are listed below for reference. The Contractor shall design and propose graphic symbol marks to be used on the variable message sign. ■ The system shall be capable of having a maximum of twenty (20) graphic symbol marks. The graphic symbol marks shall be defined as dot matrix and editing of the symbol mark shall be possible. It shall be possible to combine text and graphic symbol marks and in a sketch map. <div style="text-align: center;">  </div>
3	<ul style="list-style-type: none"> ■ The VMS system shall have an alternate display function, in which a maximum of three sets of messages shall be displayed alternately. The function is intended to display a message in three different language (English, Hindi and Tamil) of the same contents. ■ If multiple messages are displayed alternatively, it shall be possible to adjust the display duration of each message in the range of one to four seconds in units of one second. The changeover of the messages shall take place instantaneously without noticeable mixture of two message.

Message Creation and Editing Functions	
4	<p>Three message composition methods shall be provided: (1) manual input, (2) combination of pre-defined phrases, and (3) selection of ready-made message. In addition, a set of graphic symbol marks shall be provided to complement the text message.</p> <p>(1) Manual composition</p> <p>In the manual input, it shall be possible to display any text message inputted by the system operator using the keyboard of the console in the TMC. There shall be no restriction as to the contents of message, but the length of message is limited to the display capacity of the VMS board. If manual composition mode is selected, the operator console shall show the image of the VMS board and the message as it is entered by the system operator.</p> <p>(2) Combination of pre-defined phrase</p> <p>In the case of combination of pre-defined phrase, frequently used words or phrases such as “accident”, “congestion”, “construction work”, “slow down” and so on are used to compose a message. It shall be possible to insert a word into the message composed by combination method.</p> <p>There shall be sets of pre-defined words. They shall contain words indicating location, incident and action. Each set shall have a capacity of 100 words in each language. In this mode, the operator console shall show the categories and the words or phrases in each category for the system operator to select. It shall be possible to alter the pre-defined words by the system operator.</p> <p>(3) Ready-made message</p> <p>Ready-made message selection method shall allow the system operator to choose one of the ready-made messages. If the ready-made message mode is selected, the operator console shall indicate the list of ready-made messages grouped into categories for the system operator to select.</p> <p>Message set shall have the capacity of 100 messages in each language.</p> <p>(4) Graphic symbol marks</p> <p>Graphic symbol marks that show typical incidents such as construction work and heavy rain shall be provided to complement the text message.</p> <p>(5) Dot matrix pattern</p> <p>The VMS System shall be provided with a function to create a display pattern by specifying the on/off status and color of each pixel comprising the display area of the VMS board. It shall be possible to mix the dot matrix pattern and character message on the board.</p> <p>(6) Automatic message creation from incident information</p> <p>The operator console shall be provided with updating and editing function of pre-defined word, phrase, message and symbol mark. Editing of symbol mark shall be possible on a pixel basis. Graphic user interface shall be adopted in the interface as much as possible for user friendly operation and fail-safe mechanism shall be incorporated to prevent VMS System from showing inadequate message. The system shall be equipped with a text input method in Tamil and English languages commonly used in Chennai through the standard keyboard.</p> <p>Each message being displayed on the VMS shall be assigned with a time-to-live (TTL) value and upon expiration of TTL, message shall be automatically extinguished. A warning shall be issued to the operator console before TTL expires for operator to choose extension of TTL or</p>

	<p>termination of the display as scheduled.</p> <p>(7) Message priority</p> <p>The VMS system shall be provided with an automatic message selection function based on the priority or severity of the events and coefficient that represents the importance of event to each VMS. The function shall select and recommend the message to be shown separately for each VMS when there are two or more events to be informed to road uses.</p>
Simple Schematic Map	
5	<p>Simple schematic map with following traffic status shall be shown in real time for dedicated location from the VMS.</p> <p>The following information shall be displayed on the simple schematic map of the main road for down flow area of the VMS.</p> <ul style="list-style-type: none"> ■ Congestion level and Congested section by color coded ■ Travel time from the VMS to dedicated location ■ Mark of Event, Construction, Closure of road, etc <p>The graphic type VMS shall be multi-color type for better presentation of contents.</p>
Data Transmitting Functions	
6	<ul style="list-style-type: none"> ■ Text and symbol mark message to be displayed shall be converted to pixel image data before transmitting to the variable message sign. ■ The VMS server shall communicate with the VMS controller at roadside through the network of the communication carriers. It shall send dot pattern converted message for display. It shall also send out command data to control the VMS controller and to confirm normal operation of the VMS board. In return, the server shall receive status data from the controller.
Operation Monitoring and Logging Functions	
7	<ul style="list-style-type: none"> ■ Operating status of the VMS shall be checked periodically. Status (message on, no message, fault, local control, test and switch off) shall be collected from the roadside VMS controller. If any abnormality is reported, an alarm shall be issued. The collected operation monitoring data shall be recorded as part of operation log. System operator using his operator console shall be able to send a command to the controller and collect the dot pattern data being displayed on the VMS board. ■ Displayed message along with the starting and ending time shall be recorded as operation log. ■ System shall be able to show live health status of each field component, sup components in control center and system shall be able to generate alert and display in the control room for following status as per EN 12966 but not limited: <ul style="list-style-type: none"> a. Power status (Law power, UPS), b. Low battery alert, c. Cabinet/VMS Board door Open, Close d. Connectivity status e. Processor PCB Failure f. LED Cluster Failure g. Loss of incoming message/ data not properly received h. Temperature status i. Controller alert etc. ■ Status or malfunction of the VMS and the controller shall also be recorded. Data retrieval software shall be provided to display the operation log on display monitor and as also to print as report. ■ The Bidder shall state in his proposal, the types of error and malfunction of the VMS System that can be diagnosed from the VMS server.
Monitoring Function	
8	<ul style="list-style-type: none"> ■ The VMS system shall have the monitoring function on schematic map as well in the form of a list

	<p>■ The VMS server shall be capable of creating not be limited to the following monitoring contents:</p>			
	Item	Contents	Graphic	List
	Equipment location and status	Location of VMS and their condition (message/no message and normal/error)	<input type="checkbox"/>	<input type="checkbox"/>
	VMS Message	Message currently being displayed	<input type="checkbox"/>	<input type="checkbox"/>
		Message display log		<input type="checkbox"/>
	Message	Pre-defined words and phrases in the form of list Pre-defined message in the form of list		<input type="checkbox"/>
	Symbol	Graphic symbol marks	<input type="checkbox"/>	
	Operating log	Error log (data and time of failure and recovery)		<input type="checkbox"/>
	Parameter	Parameters for viewing and editing		<input type="checkbox"/>

5 Hardware Requirement

All hardware equipment shall as a minimum, meet all the requirements listed in the specifications. The equipment's provided shall accommodate to future technological advances which exceeds the minimum requirements provided in the specifications.

5.1 VMS Board and Controller

Table 5-1: Hardware Requirement of VMS Board and Controller

No.	Item	Specifications
1.	Board size	8,000 mm (W) x 3,000 mm (H)
2.	Character height	300 mm or more
3.	Display	<ul style="list-style-type: none"> ■ Two (2) or more lines messages shall be required ■ Graphic symbol and Schematic map shall be displayed ■ Three (3) languages as English, Hindi and Local shall be required ■ The Contractor shall propose the number of characters to be displayed per line in case of English, Hindi and Local languages.
4.	LED Type	<ul style="list-style-type: none"> ■ Full Color, class ■ designation C2 as per
5.	Pixel Pitch	10mm or less
6.	Pixel Configuration	1R/1G/1B
7.	VMD Size & Active Area	Customized
8.	Cabinet Pixels	10000/m ²
9.	Pixel Density	10,000 dots/m ²
10.	Environmental grade	UV Resistant
11.	Color type	Real Full Color
12.	Brightness	7000-7500 cd/m ² (Ensure excellent Images)

13.	Luminance Control & auto Diming	<ul style="list-style-type: none"> ■ Should automatically provide different luminance levels but shall also be controllable from the control center using software. ■ Auto dimming capability to adjust to ambient light level (sensor based automatic control) ■ Photoelectric sensor shall be positioned at the sign front and sign rear to measure ambient light. Capable of being continually exposed to direct sunlight without impairment of performance.
14.	Best Viewing Distance	300m or more, Character size of 300m
15.	Power Consumption	Maximum 400W/m ² Average 200W/m ²
16.	Control Method	Synchronized with System
17.	Frame Frequency	≥60 Hz.
18.	Grey Level	≥ 16K Grade
19.	Color Temperature	6000K-95000 K
20.	Color	≥16 Million Colors
21.	Working Temperature	-10°C ~ 60°C
22.	Humidity	10% to 95%
23.	Refresh rate	≤1920 hertz
24.	Defect Ratio	≤0.1%
25.	Video Interface	Supports RJ45 and DVI
26.	Communication	Wired through RJ45/Wifi/SIM based router
27.	Life Span	1,00,000 HRS
28.	Operating Windows for site processor	Windows 10 OS
29.	Viewing Angle	Horizontal ≥120° / Vertical ≥60°
30.	Functional features	The VMS boards should have the facility to generate Real Time information of Traffic Data i.e. Traffic Live Congestion, Journey Time, Traffic rerouting, automatically using a site processor embedded system.
31.	Pixel level diagnostics	The System should be capable of detecting the failure of Single or multiple LEDs (Red, Blue, Green separately) and has to send the alert to the CCC on the exact location of the failed LEDs.
32.	Door Alarm	The System should be capable of detecting the unauthorized access of the display door and must send the alert to the central control center on the exact location of the failed LEDs.
33.	Flat Cable, SMPS Voltage:	The System should be capable of showing the health status of FRC cable & SMPS Voltage etc.
34.	Power Consumption	The display should not consume more than 400W/m ² at the minimum brightness of 7000cd/m ² .

35.	Auto brightness Sensor	The Sensor should be capable of handling all kinds of weather conditions and the light sensor has the control circuit to increase the stability and photo sensitivity.
36.	VMS Controller	<p>1)The Software should run on Microsoft Windows Platform: Windows7 Embedded or Required OS to meet SLA & Functionality</p> <p>2) The Software powers up the Media Player at pre- determined times on all functioning days of the Station.</p> <p>3) The Software powers off the unit during the closing hours of the Station.</p> <p>4) No Personnel should be required to either switch on, switch off, power off, log in or log out procedures. All the above functions should function automatically as scheduled.</p> <p>5) Multiple Screen Layouts & independently schedulable Zones.</p> <p>6) Play Standard Multimedia Files: Flash, Videos, Images, etc.</p> <p>7) Time-Sensitive Content – Expired old content to be purged.</p> <p>8) Unattended, Continuous Playback</p> <p>9) Remote Shutdown, Reboot Mode.</p> <p>10) Connect on “as-and-when-needed” basis</p> <p>11) Should be able to use fiber, Wi-Fi, or SIM based router for connectivity. Support closed networks (VPN)</p> <p>12) No need of dedicated bandwidth. Should be operational even if server connectivity is down.</p> <p>13) Play Scheduled Playlist in day parts</p> <p>14) Proof of Play and Log Retrieval</p> <p>15) Support Major Indian Language Fonts</p> <p>16) Minimum 4 GB RAM and 64 GB Flash, 1.66 GHZ</p> <p>17) It should be able to work unattended for 24x7 operations.</p> <p>18) It should support offline content playback in case of internet/network outage.</p> <p>19) Temperature and humidity sensor shall be inbuilt in controller.</p>
37.		20) The LED Cluster consist of individual LED`s encapsulated in a resonated plastic housing proving protection to the elements. Housing - Powder coated housing with ingress protection class P2 as per EN12966;
38.		21)Vertical Clearance for fixed VMS is at least 5.5 meter which can bear wind load up to 200kmph and the concrete pedestal for gantry support column should not exceed more than 1.5m
39.		22)Failure of one LED module should not affect the output of any other LED cluster
40.		23)The controller capable of automatically diagnosing and reporting component failure or any electronic fault.
41.		24)Color, Luminance & Luminance Ratio - Luminance shall be min LEVEL 2 and Luminance ratio shall be R2 as per beam width min. B3 according to N12966
42.	Others	<p>26) In case of internet outage, processor should be able to discard live content slides & play only static slides. Once the internet is established, it should automatically play both live and static content without any manual intervention.</p> <p>27) VMS processor should support auto reboot feature in case of system error pop ups automatically.</p>

		28) VMS processor should be able to showcase dynamic animations based on the weather conditions in real time for weather content slides.
		29) LED OEM Bin certification for each used LED in VMS board shall submit by Contractor.
		30) Life of Components of VMS should be more than 10 years

5.2 Network Infrastructure

The Contractor shall supply and install network equipment at each location to connect each peripheral to the system. The Bidder shall supply and install all equipment, cables, connectors, terminals and other miscellaneous materials necessary to establish a working local area network connecting these systems. The network between the Control Center and sub-systems shall either use the optical fibre cable network or high-end Wireless Access Points along the Project Area and a data communication network shall be established using layered switches to be supplied by the Contractor.

The type and the number of the network equipment proposed by the Bidder as per the network design shall be mentioned by the Bidder in the BOQ. The network configuration shall be determined by the Bidder. The cost of the network devices and materials that is not explicitly listed in the BOQ of the Bid submitted by the Bidder or supplied by the Bidder during the installation works but deemed necessary for the system during any stage of this Contract shall be included in the cost of appropriate items and the Contract Price, and no separate payment shall be made.

5.3 Power Supply and Outdoor UPS

Power supply and UPS shall be provided at each VMS location. The Bidder shall present the calculation of power consumption and capacity of power supply system to be used for the VMS. The Bidder shall also consider the power requirement of network devices, wireless access points, switch, etc. suitably during the calculation. Proper earthing shall be provided at each equipment location.

The type and the number of the Power supply, Electric Meter proposed by the Bidder as per the design shall be mentioned by the Bidder in the BOQ. The cost of the Power Supply devices and materials that is not explicitly listed in the BOQ of the Bid submitted by the Bidder or supplied by the Bidder during the installation works but deemed necessary for the system during any stage of this Contract shall be included in the cost of appropriate items and the Contract Price, and no separate payment shall be made.

Table 5-2: Hardware Requirement of Outdoor UPS

No.	Item	Requirements
1.	Input / Output Voltage	<ul style="list-style-type: none"> ■ AC 230 V / 50 Hz basically. ■ Output voltage: AC 230V/50Hz ■ Commercial Power generally but with existing condition of power failure, instantaneous power failure and voltage fluctuation

2	UPS	<ul style="list-style-type: none">■ The UPS shall be of True online with double conversion topology.■ The UPS shall work in outdoor environment to ensure all equipment's getting necessary power supply. No power surge.■ The UPS unit shall have load level indicators that display the approximate electrical load placed upon the UPS. The UPS unit shall have a row of battery level indicators that display the approximate battery capacity.■ The UPS unit shall have a minimum of the following as per OEM standard indicators:<ul style="list-style-type: none">➤ UPS Mode: On-line, Backup/Battery and Bypass;
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		<ul style="list-style-type: none"> ➤ Over Load Indicator: This will display when UPS is running on overload; ➤ Battery Status Indicator: This will illuminate when battery is low or faulty/disconnected; and ➤ System Fault: This will illuminate when there is some fault or interruption in UPS. <ul style="list-style-type: none"> ■ The UPS unit shall include Ethernet communication port to support remote management and monitoring capabilities using SNMP including alarm contacts and remote shutdown. Remote monitoring and testing software shall be included. The manufacturer shall provide all SNMP traps. ■ The UPS unit shall include automatic restart. Upon restoration of utility AC power after complete battery discharge, the UPS shall automatically restart and resume operation. ■ The UPS unit shall be compliant to IEC 62040-1, CE, IEC602040-2 safety standards. ■ The UPS and batteries shall be mounted in a separate cabinet & the enclosure shall be under lock & key, utilising the minimum possible space and arranged in an aesthetic manner. ■ Any field UPS system (as per MSI's design) shall be supplied with an environmentally rated cabinet for installation of the UPS and batteries. The cabinet shall have a rating of IP 55. The cabinet shall be supplied with in-built fans and proper ventilation as needed to ensure that the temperature inside the cabinet does not exceed 40 degrees C at any given point in time. ■ Backup time at least 3 hrs or more
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5.4 Gantry

Table 5-3: Hardware Requirement of Gantry

No.	Item Specification
1.	<ul style="list-style-type: none"> ■ The minimum vertical clearance between the finished road surface and the bottom of the support structure/bottom of the VMS (whichever is lower) shall be 5.5 m as per IRC/MORTH guidelines. ■ The structure for VMS mounting should be designed for wind speeds as per IS-875 part 3. ■ The structure should have a ladder near the vertical poles with locks. ■ The structure should be able to bear the load of the display board. There should be enough space at the back for opening of the back door for service. ■ The mounting should be capable of withstanding roadside vibrations at site of installation. ■ VMS structure should have suitable walkway for maintenance access. ■ The side interior and rear of enclosures should be provided in maintenance free natural aluminum finish. All enclosure shall be flat and wipe clean.

5.5 Cabinet/VMS Board

Table 5-4: Hardware Requirement of Cabinet/VMS Board

No.	Item Specification
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1.	■ The cabinet/VMS Board shall be electrically and mechanically robust and shall have a
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	<p>degree of protection of IP65 or higher specified in “IEC60529 Degrees of Protection Provided by Enclosures (IP Code)”.</p> <ul style="list-style-type: none"> ■ The cabinet/VMS Board shall have the provision for temperature controlling for optimal performance of equipment. ■ The power supply including UPS shall be provided with a circuit breaker for cabinet. ■ The anti-lightning and surge protection complying with the IEC61643-1 shall be provided. ■ Protection under/overvoltage condition shall be provided. ■ Monitoring status of temperature, battery and power supply ■ Finished with the anticorrosive treatment ■ An internal lighting system ■ 220VAC plugs protected by a differential circuit breaker ■ An intercom jack ■ A file holder for the documentation ■ Standard key locks ■ Fixed on metallic cabinet frames (when false floor)
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6 Communication Requirement

Table 6-1: Communication Requirements of VMS

No.	Requirements
1.	<ul style="list-style-type: none"> ■ Communication between the VMS server in the TIMS-CCC and the VMS board shall be Wireless 3G/4G or upcoming 5G Connectivity provided by a single communication company. ■ The required bandwidth to ensure the stable communication connectivity shall be proposed by the Contractor and subsequently approved by the Engineer.

7 Installation Requirement

The Contractor shall make the provision for necessary civil, foundation, earthing, necessary cable conducting, manhole, Power supply, redundant communication, new meter connection, quality, safety and last mile connectivity etc. to meet the functional requirement intended for the system.

The Contractor shall obtain necessary permission from respective agency.

VMS will be installed on the gantry along the road. It will be incorporating a standard prefabricated pole, housing a VMS and a platform for rear maintenance access. This type of VMS structure is durable, safe, easy to access feature does not need traffic to be blocked for maintenance/service and adds aesthetics to a city and highway. The structure should be modular and retrofittable for poles & gantries.

The VMS system shall be:

- The VMS shall be installed above 5.5m the bottom of board from the ground level.
- The VMS board shall be mounted on a gantry of suitable design and construction.
- The VMS board shall be installed at the location having visibility of at least visibility of 300 meter. Minimum clearance from road surface shall be kept under the bottom of VMS board.
- The VMS board shall be fixed on gantry type supporting structure. The construction of gantry support shall be part of the contract.
- The Contractor shall design the gantry support and their foundation taking into consideration such as weight of VMS, bearing capacity of ground, wind load, fixing method of VMS board with the gantry support, power receiving and network connecting points, and grounding method. The width of the gantry shall be adjusted to the road width at the location.
- The location for VMS given in this RFP is tentative. However, Contractor shall conduct the geotechnical survey and accordingly design the gantry foundation and gantry structure for Engineer approval with Geotechnical report.
- The Contractor shall obtain the approval for the above calculation sheet from the Engineer.

- A mechanism to adjust the tilting angle of VMS shall be provided for the VMS housing or fixture that is used to attach the VMS to the support.
- It shall be possible to adjust the tilting between 0 degree (vertical) and 10 degrees (tilted forward).

The Contractor shall undertake foundation work for the gantry and cantilever support, communication cable and power cable works, protection against lightning, earthing and other works incidental to the installation of VMS.

Chapter 2-6 Requirements of Speed Limit Violation Detection System

1 General

The Speed Limit Violation Detection (SLVD) System will be installed in 10 strategic locations to improve safety by enforcement.

The system should be capable to capture the infractions of speed violations at specified locations and will generate an automatic alert and generate challan. The system should be equipped with a camera and Radar system to record a digitized image/ video frame of the violation, covering the violating vehicle. The system should be capable of capturing multiple infracting vehicles simultaneously in defined lanes at any point of time simultaneously with relevant infraction data like:

- (a) Type of Violation
- (b) Speed of violating vehicle
- (c) Notified speed limit
- (d) Date, time, Site Name and Location of the Infraction.
- (e) Small video for evidence (video from t-5 to t+5 sec of the violation with at least 10fps)
- (f) Generate sufficient evidential proof that the incident has taken place to ensure the functioning of system.

Registration Number of the vehicle through ANPR Camera system for each violating vehicle. The system shall provide the number. of vehicles infracting simultaneously in each lane. The vehicles will be clearly identifiable and demarcated in the image produced by the camera.

2 System Configuration

The SLVD system configuration is shown in figure below.

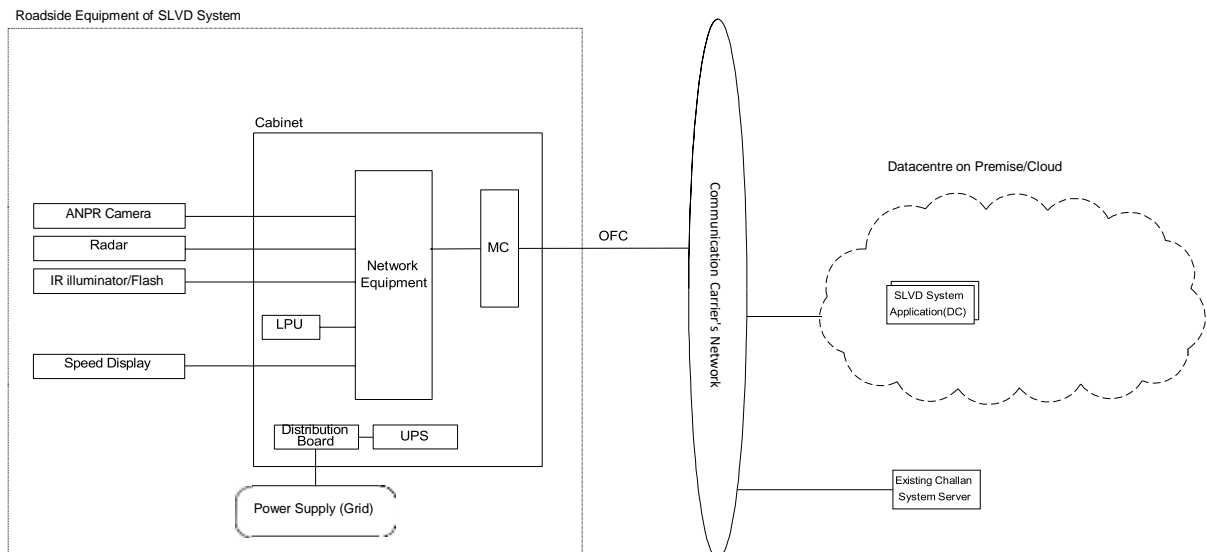


Figure 2-1: System Configuration of SLVD

3 Location and Type

The proposed locations for Speed Limit Violation Detection System (SLVD) are shown below in the Table. The Contractor shall adhere to the proposed locations as much as possible to satisfy the above requirement. In case of any changes in the locations the Contractor shall get the written approval from the Engineer based on the alignment, geometry, viewing area (based on site visit).

Table 3-1: Target Locations of SLVD

No.	Latitude	Longitude	Location Description
1	13.06087	80.28273	Near Pwd Office Kamraj salai
2	13.07726	80.28017	Anna Salai - Near Thomas Munro
3	13.0701	80.28473	Kamrajar Salai -Just After Napier Bridge
4	13.01184	80.21937	Anna Salai -Front of Tamilnadu Polution Control Board
5	13.02843	80.23583	Anna Salai - Front of Sundaram Moters Honda Dealer
6	12.99903	80.19276	Gst Road - Opp. to OTA
7	13.07883	80.19879	Inner Ring Road - Near VR Mall
8	13.04422	80.270195	Cathedral Road - Near Korean Embassy
9	13.00036	80.24817	OMR Road - Near Madhya Kailash
10	13.12157	80.19992	Annan Nagar-Grand Northern Trunk Rd, Near Indian Oil Petrol Pump

4 System Functional Requirement

The system should detect and record evidence of over speeding vehicles. Unmanned detection should be provided day and night. It should consist of several ANPR grade cameras installed on the road, on suitable gantry, pole, or any other suitable structure (Capture Point Units) connected to the Central control room. It should be possible for a number of such Capture Point Units to be connected to the same Central control room.

Vehicle speed should be detected by physical Sensor single Doppler multi-vehicle tracking radar system. The sensors should detect any violating vehicles and give capture command to the camera for capturing images of the number plate of the violating vehicle. Single radar should be able to capture speed of vehicles on 4 lanes and can be upgradable to 6 lanes in the future or based on camera-based technology single camera per lane.

4.1 SLVD Application

Table 4-1: Functional Requirement of SLVD Application

No.	Requirements
Centralized management	
1	The SLVD application shall be able to work as Management Client connected to the management server enables full remote system configuration of all servers, failover servers, devices, rules, schedules, and user rights.
Alarm Manager	

2	<ul style="list-style-type: none">■ SLVD central application shall be a single-point alarm function that provides a consolidated and clear overview of security and system-related alarms.■ A dedicated tab for the Alarm Manager shall be available in the SLVD application.■ SLVD application shall have an alarm list with extensive filtering capabilities and an alarming preview in both live and playback mode.■ Extensive alarm sort and filtering functions allow operators to focus on the most critical alarms.■ Instant preview of primary and related ANPR cameras helps reduce the number of false
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	<p>alarms.</p> <ul style="list-style-type: none"> ■ SLVD application shall have a tight integration with the map function allows operators to indicate and acknowledge active alarms on the map. ■ Alarm descriptions and work instructions make alarms actionable for operators. ■ Alarm escalation and alarm forwarding possibilities allow operators with appropriate skills to handle different alarms. ■ SLVD application shall have alarm reports to enable incident documentation. ■ SLVD application shall have an alarm location map that presents the alarm operator with a map showing the alarm area when an alarm is selected. ■ SLVD application shall have the function of alarm notification to a single or a group of SLVD application users using Push Notifications. ■ Optional sound notifications for different alarm priorities for notification of new incoming alarms. ■ The alarm disabling option enables users to suppress alarms from a given device at a certain time. ■ Instant access to both live and recorded incident from the cameras that are related to the alarm handling reports give valuable information about alarm inflow and alarm handling performance
Centralized Search for End-user	
3	<ul style="list-style-type: none"> ■ SLVD application shall be able to be to search offense sequences, bookmarks, incidents, alarms, vehicles, people, locations, and events. Save search templates. Visualize the location of Search results. ■ Dedicated tab for Centralized Search (replacing Sequence Explorer) ■ Visualize the location of Search results. ■ Save search templates including SLVD list and time scope. ■ Preview of selected search results with direct options for export of video, making bookmarks, exporting to pdf, and more formats. ■ Hide/show search results that are not matched on all search agents.
Metadata support & Storage	
4	<ul style="list-style-type: none"> ■ Received images & Videos need to be automatically saved in storage devices of including Location ID, camera ID and respective time, etc. The minimum storage capacity shall be for at least 1 year or more. ■ All data transmitted from the SLVD equipment and processed data in the CCC are recorded and stored for analysis and future usage. Data retrieval and presentation software Should be provided that can easily retrieve and show the movie image and still image of the specified Incident at the hour or day. ■ Status of roadside equipment (normal or malfunctioned) should be recorded in the server as an operation log and for future reliability analysis together with error code and time stamp. ■ Each storage container is defined as a live database and one optional archive, where the video data, Images are moved from the live database to secondary disk systems or network drives. The archived data is still online and available for clients ■ Each evidence and incident data shall be available for the length required for judicial activity.
Intuitive map function	
5	<ul style="list-style-type: none"> ■ SLVD application shall be able to show a Schematic road map of the location. The map shall be Smart Map with intuitive map function with below give features: ■ Multi-layered and interactive maps display the location of every Junction and offer control of the entire SLVD system. It shall also have seamless drag-and-drop integration with a Smart video Wall. ■ Seamless geo-navigation supporting map services such as Bing, Google, and Open Street Maps as well as georeferenced GIS maps and CAD drawings, with drill-down possibilities to the classic maps. ■ Map images can be in standard graphic file formats including JPG, GIF, PNG, and TIF ■ Easy drag-and-drop and point-and-click definition of SLVD cameras, ANPR Camera servers. ■ Real-time status monitoring indication from all system components including cameras, I/O devices, and system servers

Evidence export	
6	<ul style="list-style-type: none"> SLVD central application shall be able to deliver authentic evidence to public authorities by exporting evidence to various formats, including video, images, vehicle numbers from multiple cameras in an encrypted format with dedicated player application included.
Integration options	
7	<ul style="list-style-type: none"> Supports display of MIP SDK plug-in items on the Smart Map The SLVD application shall be able to enable integrations to third-party Mobile or Web applications at the data level. Application's Driver Framework enables device manufacturers to develop their drivers for SLVD applications using their SDK.
Alerting and notification	
8	<ul style="list-style-type: none"> The system shall be able to show the live health status of each field component, subcomponents in the control center, and the system shall be able to generate alerts and display in the control room for the following status but not limited: <ul style="list-style-type: none"> h. Power status (Law power, UPS), i. Low battery alert, j. Cabinet door Open, Close k. Connectivity status l. Temperature status m. Camera status n. LPU alert etc
Logs	
9	<ul style="list-style-type: none"> SLVD application shall be able to show logging of system, audit, and rule entries to the management server with local caching during offline scenarios. Logs of system, audit, and rule entries are consolidated from all recording servers and clients. Each log file has the adjustable size and time limitations All the Logs from LPU to Server shall be synchronized and stored for audit purposes in sequence at least for 180 days
Operation Support	
10	<ul style="list-style-type: none"> The system would dispatch alerts for all violations detected to the control room in near real-time. The details of each violation transaction shall include <ul style="list-style-type: none"> ✓ Type of Violation ✓ Details of Violation: vehicle speed and/or vehicle direction ✓ License Plate Number along with thumbnail of the License Plate ✓ At least 2 Timestamped Snapshot(s) of the Violation for Evidence ✓ minimum 5 seconds video for evidence ✓ Camera Location and Site Details ✓ Shall be expandable up to 50 location
11	<ul style="list-style-type: none"> The system shall provide option to configure different speed limits for different stretches depending on their location in the city/highway. The system shall provide option to configure different speed limits for different time-periods.
12	<ul style="list-style-type: none"> It should be capable of importing violation data for the Operator for viewing and retrieving the violation images and data for further processing. The programmed should provide for sort, transfer & print command. Image zoom function for number plate and images should be provided.
13	<ul style="list-style-type: none"> The user interface should be user friendly and provide facility to user for viewing sorting and printing violations. The software should also be capable of generating query based statistical reports on the violation data.
14	<ul style="list-style-type: none"> All outstation units should be configurable using the software at the Central location. The operator at the back office should be able to get an alarm of any possible fault(s) at the camera site (outstand) (e.g. sensor failure, camera failure, failure of linkage with radar, connectivity failure, Camera tampering, sensor tampering).

15	<ul style="list-style-type: none"> Basic image manipulation tools (zoom etc.) should be provided for the displayed image but the actual recorded image should never change.
Alert Generation	
7	<ul style="list-style-type: none"> System shall be able to show live health status of each field component, sup components in control center and system shall be able to generate alert and display in the control room for following status but not limited: <ul style="list-style-type: none"> a. Power status (Law power, UPS), b. Low battery alert, c. Cabinet door Open, Close d. Connectivity status e. Illuminator Status f. Temperature status g. Camera status h. LPU alert etc.
Reporting	
8	<ul style="list-style-type: none"> The data provided for authentication of violations should be in an easy-to-use format as per the requirements of user unit. User should be provided with means of listing the invalid violations along with the reason(s) of invalidation without deleting the record(s).
Data Recording	
9	<ul style="list-style-type: none"> Image should have a header and footer depicting the information about the site IP and violation details like viz. date, time, equipment ID, location ID, Unique ID of each violation, lane number, Registration Number of violating vehicle and actual violation of violating vehicle etc. so that the complete behavior is recorded viz. (Speed of violating vehicle, notified speed limit, Speed Violation with Registration Number Plate Recognition facility). Number plate of cars, buses/HTVs should be readable automatically with the OCR feature by the software/interface. There should be user interface for simultaneous manual authentication / correction and saving as well. All data pertain to the infraction shall be stored at least 1 year at server storage.
E-Challan Coordination	
10	<ul style="list-style-type: none"> The SLVD system Including ANPR capabilities should be integrated with the various application and Databases like VAHAN, and e-Challan application (to be integrated under this project), etc. such that e-Challans can be generated by the system through an automated process. The data shall be transferred to the CCC in real-time for verification of the inspection and processing of E-challan. The system shall be integrated with the RTO database/Vahan to fetch required information as per client requirements. The system shall be able to track the entire life cycle of Challan from beginning to end (Offence Evidence, Generation, Authorize By, Penalty amount status, Dispatch detail, Challan status, etc.)
Safety Function	
11	<ul style="list-style-type: none"> The system should have the capability to transfer the data to the CCC through proper encryption in real time and batch mode for verification of the infraction and processing of challan. Call forwarding architecture shall be followed to avoid any data loss during transfer. If the connectivity to the CCC is not established due to network/connectivity failures, then all data pertaining to the infraction shall be stored on site and will be transferred once the connectivity is re-established automatically. There shall also be a facility of physical transfer of data on portable device whenever required. There should be a provision to store minimum one week of data at each site.
Security	
12	<ul style="list-style-type: none"> Rights to different modules / Sub-Modules / Functionalities should be role based and proper log report should be maintained by the system for such access. Roles and Rights of users shall be able to be defined in the system.

13	<ul style="list-style-type: none"> ■ The architecture must adopt an end-to-end security model that protects data and the infrastructure from malicious and virus attacks using anti-virus and Firewall provisions for security of field equipment as well as protection of the software system from hackers and other threats shall be a part of the proposed system. ■ The system shall be configurable remotely
14	<ul style="list-style-type: none"> ■ Log of user actions be maintained in read only mode. User should be provided with the password and ID to access the system along with user type (admin, user).
15	<ul style="list-style-type: none"> ■ The system should have secure access mechanism for validation of authorized personnel.
16	<ul style="list-style-type: none"> ■ A log of all user activities should be maintained in the system.
Data Retrieval and Reports	
17	<ul style="list-style-type: none"> ■ The system shall enable easy and quick retrieval of snapshots (maximum 10 seconds) and other data for post incident analysis and investigations. Database search could be using criteria like date, time, location, and vehicle number. The system shall be able to generate suitable MIS reports as desired by the user. The system shall also provide advanced and smart searching facility of License plates from the database. ■ The system shall enable to correct or generate the vehicle number in Database after manual check of image.

4.2 LPU (Local Processing Unit)

Table 4-2: Functional Requirement of LPU

No.	Requirements
Automatic Number Plate Recognition	
1	<ul style="list-style-type: none"> ■ The automatic number plate recognition Software may be part of the supplied system or can be provided separately as add on module to be integrated with violation detection radar. The accuracy rate of ANPR will be taken as 80% or better during the daytime and 60% or better during the night-time on standard number plates.
2	<ul style="list-style-type: none"> ■ On Site out station processing unit communication & Electrical Interface should automatically reset in the event of a program hang up and restart after power failure.
3	<ul style="list-style-type: none"> ■ A closer view indicating readable registration number plate patch of the violating vehicle for evidence for each violation should be taken by an ANPR camera. ■ System should be able to recognize the entire event by which the same can be justified automatically by fetching the number plate of cars in violation. ■ Normal and Retro-reflective number plate capture: ANPR camera should be able to capture both “Retro reflective”, “Non-reflective” and “High Security “ etc. type of number plates found in India
Speed Limit Violation Detection	
4	<ul style="list-style-type: none"> ■ The system should be capable of detecting violations of over-speeding by using Doppler radar-based system (locally at LPU) only. The accuracy rate of the speed limit violation detection shall be 92% or better.
5	<ul style="list-style-type: none"> ■ The system should be able to detect the speed of multiple vehicles traveling in different lanes covered in the camera view simultaneously.
6	<ul style="list-style-type: none"> ■ The system should be able to compare the speed computed for each vehicle with the pre-defined speed limit for the violation when the speed limit is exceeded.
7	<ul style="list-style-type: none"> ■ Measurement may be made by using non-intrusive technology such as Radar integrated camera or individual radar and homologation certificate from Ministry of Traffic or equivalent department from respective country of origin, document authenticated by Indian Embassy (to authenticate that systems are legalized and tested for infractions to avoid legal issues) or Certificate from internationally accredited metrology laboratories (approved for speed calibration) is acceptable

	<ul style="list-style-type: none"> ■ Radar shall be capable to detect speed of vehicle from more than 120 meters.
Data Recoding	
8	<ul style="list-style-type: none"> ■ The output of the OCR process and all captured images shall be stored on an industrial processing unit and also transmit to CCC. ■ If the connectivity to CCC is not established, then all data pertain to the infraction shall be stored at least 7 days on site and will be transferred once the connectivity is re-established automatically. If when the data storage reaches capacity, the image processor shall automatically over-write the oldest data.
9	<ul style="list-style-type: none"> ■ ALL vehicle ANPR capture system: The over speed enforcement systems should also be capable of capturing number plate and images of all vehicles passing through the installed location. All vehicle images and numbers should be transmitted to control room and kept in database for real time alerts or for post search for analysis purposes.
Lane Coverage	
10	<ul style="list-style-type: none"> ■ Rader and ANPR camera system shall cover at least multiple three (3) lane.
Detection Speed	
11	<ul style="list-style-type: none"> ■ ANPR cameras deployed should use Fast electronic shutter (low exposure time) should be used to capture even vehicles moving at 180 km/h without any image blur. Frame rate should be sufficient to capture all violations and all vehicle ANPR video.
IR Illuminator /Flash unit	
12	<ul style="list-style-type: none"> ■ Integrated external Infrared/Flash shall be capable to take images in nighttime and automatically detect number plate at distance of minimum 30 meters. The IR/Flash should be integrated with camera unit with single power source and synched speed shall be 1/2000TH of second
System Mounting	
13	<ul style="list-style-type: none"> ■ System can be composite unit with all components inside the IP66 box OR comprised of camera or other units mounted on poles with controller and processors at side poles to make sure all lanes of the road are covered.
Traffic Violation Detection	
14	<ul style="list-style-type: none"> ■ Minimum following "SLVD Analytics" shall be part of the SLVD System. The incidents to be detected by the SLVD System shall be " Speed Limit Violation", and "Automatic Number Plate Recognition", ■ The system shall have the function to enter manually for an offense based on evidence collected by the SLVD system for further processing rather than speed violation. ■ Image zoom function for number plate and images should be provided. In case the number plate of the infracting vehicle is readable only through the magnifier then in such cases the printing should be possible along with the magnified image. ■ The system shall be able to detect all vehicles infracting simultaneously in each lane/ arm at the junction as per locations provided. It should also be able to detect the vehicles infracting serially one after another in the same lane. The vehicles should be clearly identifiable and demarcated in the image produced by the camera system. ■ The system shall have spot alert management for detection blacklist or hot listed vehicles from a control center at the LPU level. ■ Some exceptional cases will be considered for non-detection of "SLVD Analytics" such as <ul style="list-style-type: none"> a. The number plate detection could not process due to overlapping of another vehicle, b. Over speeding vehicle, c. Non-Standard Number plate. d. Number plate cover by Mud or non-readable form naked eye's e. Red Light Non-Functional or Malfunction but system shall have the functionality to track and update any such kind of alert on priority to authority and operator to register an incident f. Any other case study observed during operation and considered by the Employer /Engineer shall be considered in the non-detection exemption.

15	<ul style="list-style-type: none"> Entire functionalities define under this section shall be executed only at the LPU level and shall not be an effect due to communication interruption with Server
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4.3 Speed Display (Radar Based)

A small independent radar integrated speed display shall be installed to educate and draw attention of commuters to improve their driving behavior. The small independent radar integrated display shall be approximately 150 meters. away from SLVD. The radar-based speed display shall detect speed of vehicles up to 180 kmph and the detection zone shall be 80 meters before installed location. The Small Speed Display Board shall display speed upto three characters with warning sign for under Speed and Over Speed limit. Detecting speed accuracy shall be 10% (+-) of actual vehicle speed and shall be cover more than 3 lanes.

5 Hardware Requirement

All hardware equipment shall as a minimum, meet all the requirements listed in the specifications. The equipment's provided shall accommodate to future technological advances which exceeds the minimum requirements provided in the specifications.

5.1 Radar

Table 5-1: Hardware Requirement of SLVD Radar

No.	Item	Requirements
1	Type	Advanced Tracking Doppler Radar-K Band 24GHz FMCW (Frequency Modulated Continuous Wave)
2	Speed Range	Measurement up to 180 km/h or more
3	Speed Digits	Up to 3 Character and 16 inch or more
4	Interface	Ethernet/CAN/integrated
5	Housing	IP67
6	Drift	Negligible, no re-calibration needed over 10-year life.

5.2 Speed Display (Radar Based)

Table 5-2: Hardware requirement of Speed display (Radar based)

No.	Item	Requirements
1	Type	Dual Direction K-Band 24GHz
2	Speed Range	Measurement up to 180 km/h or more
3	Frequency	24 GHz/ 77 GHz
4	LEDs	Ultra-bright, Tri color Red, Green and Amber -Speed Display
5	Angle	30 Degree cone angle, auto diming
6	Visibility	50 meters
7	Detection range	150 meters
8	Beam Width	12 Degree Horizontal to 25 Degree vertical
9	Housing	IP 65/NEMA 4R
10	Certification	Bin certification from OEM for used LEDs in board, Govt. approval for used radar
11	Casing	Material: Aluminum
12	Character Size	16 inches
13	Luminous	Partial Flux: 9000 – 22000 EV, (Lux) Led
14	Temperature	0 to 80 Degree Centigrade

5.3 ANPR Camera

Table 5-3: Hardware Requirement of ANPR Camera

No.	Item	Requirements
1	Video Compression	H.264, H.265 or better
2	Video Resolution	2 MP or better
3	Frame rate	Min. 12 FPS
4	Image Sensor	1/2.8" Progressive Scan CCD / CMOS
5	Lens Type	Varifocal, C/CS Mount, IR Correction full HD lens or better
6	Shutter Speed	1/50 s– 1/10,000s or better
7	Lens	5~50mm or suitable lenses to capture minimum 3.5 meters lane width from a minimum height of 6.5 meters.
8	IR Cut Filter	Automatically Removable IR-cut filter
9	Day/Night Mode	Colour, Mono, Auto
10	Region of Interest	4 zones (ON/OFF)
11	S/N Ratio	≥ 50 Db
12	WDR	120 dB
13	Stream	H.264, H.265 / H.265+ Triple & Individual Configurable, At least 1 stream at 2MP
14	Streaming Method	Unicast, Multicast
15	Auto adjustment + Remote Control of Image settings	Color, Brightness, sharpness, contrast, white balance, exposure control, backlight compensation, Gain Control, True Wide Dynamic Range
17	Protocol	IPv4, IGMP, ICMP, ARP, TCP, UDP, DHCP, PPPoE, RTP, RTSP, RTCP, DNS, DDNS, NTP, FTP, UPnP, HTTP, HTTPS, SMTP, 802.1x, SNMP, QoS
18	Security	Password Protection, IP Address filtering, User Access Log, HTTPS Encryption
19	Operating conditions	As per city weather conditions
22	Video Interface	1 port (BNC) / Ethernet 1Vp-p, 75 Ohm
23	Certification	UL, EN, CE, FCC, BIS
24	ONVIF Compliance	The camera should be ONVIF Profile S & G Conformant for both present & future generation cameras of OEM

5.4 LPU (Local Processing Unit)

Table 5-4: Hardware Requirement of LPU

No.	Item	Specification
1.	CPU	Industrial or better
2.	Memory	2 GB DDR2/DDR3 RAM better
3.	Storage	minimum 1 TB SSD
4.	Network Adapter (NIC).	100 / 1000 base-t
5.	Others	The processor should be fan less type rated upto 70°

5.5 Network Infrastructure

The Contractor shall supply and install network equipment at each location to connect each peripheral to the system. The Bidder shall supply and install all equipment, cables, connectors, terminals and other miscellaneous materials necessary to establish a working local area network connecting these systems. The network between the Control Centre and sub-systems shall either use the optical fibre cable network or high-end Wireless Access Points along the Project Area and a data communication network shall be established using layered switches to be supplied by the Contractor.

The type and the number of the network equipment proposed by the Bidder as per the network design shall be mentioned by the Bidder in the BOQ. The network configuration shall be determined by the Bidder. The cost of the network devices and materials that is not explicitly listed in the BOQ of the Bid submitted by the Bidder or supplied by the Bidder during the installation works but deemed necessary for the system during any stage of this Contract shall be included in the cost of appropriate items and the Contract Price, and no separate payment shall be made.

5.6 Industrial Grade Layer -2 Switch

Table 5-5: Hardware requirement of Industrial grade Layer-2 switch

No.	Item	Requirements
1	Ethernet Interfaces	4 x 10/100/1000 Base-T PoE+ Ports auto-negotiation Plus 4 x 1000 Base-X SFP Uplink Slots (Should be loaded with 2 x 1G Single mode Industrial Grade Fiber Modules supports up to 10 Km)
2	Performance	Switching fabric 16 Gbps or more
		Forwarding rate 11.8 Mpps or more
3	PoE Budget	120 Watts
4	VLANs	512
5	Level 2 switching	IEEE 802.1, 802.3 standards, NTP, UDLD, LLDP, Unicast MAC filter, LACP, Private VLAN, Voice VLAN, VLAN double tagging (QinQ), STP, RSTP, MSTP, GARP, GMRP, GVRP, SNMPv1/v2c/v3, SNMP Inform, DHCP Server/Relay/Client, DHCP Option 66/67/82, BootP, RARP, TFTP, RMON, HTTP, HTTPS, Syslog, MRP (Client), LLDP, 802.1x, NetFlow/sFlow, port mirroring, Digital Diagnostic Monitoring (DDM)
6	Quality of Service (QoS)	Rate limit, auto QoS, ingress policing, egress queuing, and shaping
7	Multicast	IGMPv1, v2, v3 snooping, IGMP filtering, IGMP querier, MLD snooping v1, v2
8	Management	ICMP, Telnet, SSH, ARP, Syslog, SNMPv1/v2, RMON, SMTP, HTTP, HTTPS IPv4, IPv6
9	Security	Port security, 802.1x, Dynamic VLAN assignment, Dynamic Host Configuration Protocol (DHCP) snooping, dynamic ARP inspection, IP Source Guard, storm control - unicast, multicast, broadcast, SSH, SNMPv3, TACACS+
10	Power Input Voltage	12 to 56 VDC with Redundant dual power inputs with 5-PIN Lockable Terminal Block
		Reverse Polarity Protection
11	Warranty	Min 5 years
12	Power Supply	Bidder should provide Industrial Grade AC/DC DIN RAIL power supply.

5.7 SFP Transceiver

Table 5-6: Hardware requirement of SFP transceiver

No	Item	Requirements
1	Media Type	Single-Mode or compatible with operator's network to be surveyed by bidder
2	Data Rate	1250 (Mbps)
3	Grade	Industrial

5.8 Din Rail Power Supply

Table 5-7: Hardware requirement of Din rail power supply

No	Item	Requirements
1	Input Voltage	180~240VAC
2	Input Frequency	50~60Hz
3	Output DC Voltage	48VDC±10%
4	Rated Current	2.5Amp
5	Current Range	0 ~ 5Amp
6	Rated Power	120W
7	Voltage Range	48~53VDC
8	Over-Voltage Protection	55~60VDC
9	Mounting Style	DIN Rail
10	Warranty	2 Years
11	Grade	Industrial

5.9 Pole

Table 5-8: Hardware Requirement of Pole

No.	Item Specification
1.	<ul style="list-style-type: none">■ The Contractor shall conduct the detailed design for the pole based on his site survey.■ The Contractor shall conduct the appropriate measure for preventing the vibration which will affect the detection accuracy.■ All components of poles may be hot dip galvanized, all components must be well protected against corrosion, minimum thickness of zinc coatings is 85 µ m and min density 500 gm/m² on both inside and outside surfaces■ Certified BS EN 10025-4:2019 – TC■ Required Lighting arrester arrangement inside the pole.

5.10 Power Supply and Outdoor UPS

Power supply and UPS shall be provided at each SLVD location. The Bidder shall present the calculation of power consumption and capacity of power supply system to be used for the SLVD system. The Bidder shall also consider the power requirement of network devices, wireless access points, switch, etc. suitably during the calculation. Proper earthing shall be provided at each equipment location.

The type and the number of the Power supply, Electric Meter proposed by the Bidder as per the design shall be mentioned by the Bidder in the BOQ. The cost of the Power Supply devices and materials that

is not explicitly listed in the BOQ of the Bid submitted by the Bidder or supplied by the Bidder during the installation works but deemed necessary for the system during any stage of this Contract shall be included in the cost of appropriate items and the Contract Price, and no separate payment shall be made.

Table 5-9: Hardware Requirement of Outdoor UPS

No.	Item	Requirements
1.	Input / Output Voltage	<ul style="list-style-type: none"> ■ AC 230 V / 50 Hz basically. ■ Output voltage: AC230V/50Hz ■ Commercial Power generally but with existing condition of power failure, instantaneous power failure and voltage fluctuation
2	UPS	<ul style="list-style-type: none"> ■ The UPS shall be of True online with double conversion topology. ■ The UPS shall work in outdoor environment to ensure all equipment's getting necessary power supply. No power surge. ■ The UPS unit shall have load level indicators that display the approximate electrical load placed upon the UPS. The UPS unit shall have a row of battery level indicators that display the approximate battery capacity. ■ The UPS unit shall have a minimum of the following as per OEM standard indicators: <ul style="list-style-type: none"> ➢ UPS Mode: On-line, Backup/Battery and Bypass; ➢ Over Load Indicator: This will display when UPS is running on overload; ➢ Battery Status Indicator: This will illuminate when battery is low or faulty/disconnected; and ➢ System Fault: This will illuminate when there is some fault or interruption in UPS. ■ The UPS unit shall include Ethernet communication port to support remote management and monitoring capabilities using SNMP including alarm contacts and remote shutdown. Remote monitoring and testing software shall be included. The manufacturer shall provide all SNMP traps. ■ The UPS unit shall include automatic restart. Upon restoration of utility AC power after complete battery discharge, the UPS shall automatically restart and resume operation. ■ The UPS unit shall be compliant to IEC 62040-1, CE, IEC602040-2 safety standards. ■ The UPS and batteries shall be mounted in a separate cabinet & the enclosure shall be under lock & key, utilising the minimum possible space and arranged in an aesthetic manner. ■ Any field UPS system (as per MSI's design) shall be supplied with an environmentally rated cabinet for installation of the UPS and batteries. The cabinet shall have a rating of IP 55. The cabinet shall be supplied with in-built fans and proper ventilation as needed to ensure that the temperature inside the cabinet does not exceed 40 degrees C at any given point in time. ■ Backup time at least 3 hrs or more

5.11 Cabinet

Table 5-10: Hardware Requirement of Cabinet

No.	Item Specification
1.	<ul style="list-style-type: none">• The cabinet shall be electrically and mechanically robust and shall have a degree of protection of IP65 or higher specified in “IEC60529 Degrees of Protection Provided by Enclosures (IP Code)”.• The cabinet shall have the provision for temperature controlling for optimal performance of equipment.• A right hinged door shall be provided on the front to realize easy maintenance work. The turning direction of the handle shall be counterclockwise.• The power supply including UPS shall be provided with a circuit breaker.• The anti-lightning and surge protection complying with the IEC61643-1 shall be provided.• Protection under/overvoltage condition shall be provided.• Monitoring status of temperature, battery and power supply• The cabinet shall be finished with the anticorrosive treatment• An internal lighting system• 220VAC plugs protected by a differential circuit breaker• An intercom jack• A file holder for the documentation• Standard key locks• Fixed on metallic cabinet frames (when false floor)

6 Communication Requirement

Table 6-1: Communication Requirements of SLVD

No.	Requirements
1.	<ul style="list-style-type: none">■ Communication between the roadside equipment of SLVD and the SLVD server at Chennai Traffic Information and Management Centre shall be wired connectivity provided by a single communication company. If required MPLS VPN to be provided The required bandwidth for SLVD to ensure the stable communication connectivity shall be proposed by the Contractor and subsequently approved by the Engineer.

7 Installation Requirement

The Contractor shall make the provision for necessary civil, foundation, earthing, necessary cable conducting, manhole, Power supply, redundant communication, new meter connection, quality, safety and last mile connectivity etc. to meet the functional requirement intended for the system.

The Contractor shall obtain necessary permission from respective agency.

The SLVD system is installed on pole at 10 speeding locations and 11 numbers of equipment depending on the applicability of the solution. Speed detection shall be done only by using doppler radar and with ANPR by use of camera technology.

Camera's facing from front might face difficulties in capturing image during night as it faces the highbeams from ongoing traffic, but these can be eliminated by using additional IR/Flash features.

SLVD radar shall be placed on appropriate height for detection and higher accuracy.

Chapter 2-7 Requirements of Red-Light Violation Detection System

1 General

With ever increasing traffic demand, it is becoming ever more challenging for enforcement agencies to ensure public safety. One of the most important methods for enhancing traffic and public safety is enforcement. The Red-Light Violation Detection (RLVD) system would assist Chennai Traffic Police effectively in enforcement with minimal increase in human effort. The number of the RLVD to be installed is 50 Locations for the CITS Project.

The RLVD system is a system for capturing details of vehicles that have crossed the stop line at the junction while the traffic light is red. The system should be capable to detect red light status and red- light violation by video analytics method. The camera should also be used for evidence snap generation. The information so captured shall be used to issue challans to the violators.

The general requirements of the system are specified below.

- (a) The system shall be able to detect the red-light status and the red-light violation.
 - (b) The system shall be able to capture the evidence snap of the violation.
 - (c) The system shall be able to capture the license number of the vehicles violating the red light or stop line when the signal is Red.
 - (d) The system should be capable of capturing multiple infracting vehicles simultaneously in different lanes on each arm at any point of time with relevant infraction such as type of violation, date, time, site name, location of the infraction and the license number of the violating vehicle.
 - (e) The communication between the local processing unit housed in the junction box and the detection systems mounted on the cantilever shall be through appropriate secured technology.
 - (f) Generate sufficient evidential proof that the incident has taken place to ensure the functioning of system.
 - (g) To preserve the records for future analysis so that corrective actions are to be taken to curb the tendency of people to commit such incident.
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2 System Configuration

The RLVD system configuration is shown in figure below.

Figure 2-1: System Configuration of RLVD

3 Equipment Location and Type

The proposed locations for Red Light Violation Detection system (RLVD) are shown table . The Contractor shall adhere to the proposed locations as much as possible to satisfy the above requirement. In case of any changes in the locations the Contractor shall get the written approval from the Engineer.

Table 3-1: Target Locations of RLVD

Sl.No	Location Name	Latitude	Longitude	4 Corridors Name
1	EVR Salai X Gandhi Irvin Bridge Road	13.080685	80.265141	EVR Salai
2	EVR Sala X Rajaannamalai Road	13.078976	80.254701	EVR Salai

3	EVR Salai X New Avadi Road (Pachiyappas)	13.075805	80.233878	EVR Salai
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4	Kamarajar Salai X Dr. Radhakrishnan Salai	13.043386	80.279739	Kamarajar Salai
5	Santhome High Road X South Canal Bank Road	13.023979	80.273812	Santhome High Road
6	Luz Chruch Road X Royapettah High Road	13.036918	80.267533	Ramakrishna Mutt Road
7	RK Salai X Royapettah High Road	13.044582	80.266882	Dr Radha Krishnan Road
8	Sardar Patel Rd X Anna University	13.007906	80.234926	Sardar Patel Road
9	Gandhi Mandapam Road X Ponniamman Koil Street	13.018096	80.241133	Gandhi Mandapam Road
10	Sardar Patel Road X Rajiv Ghandhi Salai (Madya Kailas)	13.006641	80.247484	Sardar Patel Road
11	Rajiv Gandhi Salai X East Coast Road	12.987562	80.251664	Rajiv Gandhi Salai/ OMR
12	Anna Salai X Wallahjah Road (Anna Statue)	13.068475	80.2719200	Mount Road (Anna Salai)
13	Kamarajar Salai X Sawmi Sivanandha Salai	13.068007	80.28423	Kamarajar Salai
14	Kamarajar Salai X Pycrofts Road	13.0575230	80.2820111	Kamarajar Salai
15	Kamarajar Salai X Wallahjah Road	13.06417100	80.28346600	Kamarajar Salai
16	Anna Salai X Benny Road (Spencer Piazza)	13.062042	80.263050	Mount Road (Anna Salai)
17	Valluvarkottam High Road X Tank Bund Road	13.568539	80.242653	Valluvarkottam High Road
18	Cathedral Road X Anna Salai	13.052325	80.257696	Cathedral Road
19	Anna Salai X Kavingar Bharathidahasam Road(SIET)	13.035711	80.246089	Mount Road (Anna Salai)
20	Anna Salai X Eldams Road	13.03950	80.246960	Mount Road (Anna Salai)
21	Inner Ring Road X PT Rajan Road (Laxman Suruthi)	13.044291	80.212276	Inner Ring Road
22	North Usman Road X Bazullah Road	13.047440	80.233063	Usman Road
23	Anna Salai X CIT Nagar 1st Main Road	13.02604900	80.23137500	Mount Road (Anna Salai)
24	CIT Nagar 1st Main Road X North Road	13.022954	80.230797	Usman Road
25	Anna Salai X Jennys Road	13.01998850	80.22462860	Mount Road (Anna Salai)
26	Indira Nagar 2nd Avenue X 1st Avenue Jn(Water Tank)	12.995068	80.25238	Rajiv Gandhi Salai/ OMR
27	Anna Salai X Sardar Patel Road	13.012135	80.221317	Mount Road (Anna Salai)
28	Sardar Patel Road X Velachery Main Rd(Concord)	13.0113540	80.2232490	Sardar Patel Road
29	Anna Salai X Lampart Church (Aruna Pedestrian)	13.0152500	80.2247300	Mount Road (Anna Salai)
30	Taluk Office Road X Lourd Doss Grotto Road (MTC Depot)	13.0144820	80.2261650	Taluk Office Road
31	LB Road X Mahatma Ghandhi Road	12.9969210	80.2558280	LB Road
32	Inner Ring RoadX MH Point	13.0015184	80.1959900	Inner Ring Road

33	NSC Bose Road X Broadway Road	13.0884450	80.2853120	NSC Bose Road
34	Rajaji Salai X Jaffar Sarang Street	13.095142	80.2925150	Rajaji Salai
35	Rajaji Salai X Flag Staff Road	13.0739100	80.2856730	Rajaji Salai
36	Anna Salai X Flag Staff Road	13.0789129	80.281958	Mount Road (Anna Salai)
37	EVR Salai X Pallavan Salai (Central Railway Station)	13.0816800	80.2751400	EVR Salai
38	EVR Salai X NSK Nagar Main Road	13.075130	80.216060	EVR Salai
39	Inner Ring Road X Vinayagapuram Main Road	13.06378000	80.21164000	Inner Ring Road
40	EVR Salai X Nelson Manickam Road	13.0743600	80.2209200	EVR Salai
41	Inner Ring Road X Annai Sathya Nagar (Games Village)	13.067500	80.20862	Inner Ring Road
42	GST Road X Air Port exit gate X	12.979900	80.162930	GST Road
43	Kamarajar Promenade X Foreshore Estate Promendae(near marina beach police station)	13.0394222	80.2789943	Kamarajar Salai
44	Inner Ring Road X Anna Nagar II Avenue	13.085390	80.198530	Inner Ring Road
45	L B Road X Sardar Patel Road	13.0067030	80.2576190	LB Road
46	Inner Ring Road X Water Works Road (CIPET)	13.013756	80.204272	Inner Ring Road
47	LB Road X East Cost Road (Thiruvannmiyur)	12.9876820	80.2559480	LB Road
48	GST Road X Airport Service Road (Old Airport Jn)	12.989788	80.179215	GST Road
49	Inner Ring Road X Kaliamman Koil Street (Ty. Switched off)	13.072079	80.202083	Inner Ring Road
50	Green Ways Road X Durgabhai Deshmukh Road	13.018605	80.261248	Greenways Road

5 System Functional Requirement

The RLVD shall be installed on all approaches to the identified junctions. The RLVD system shall automatically detect vehicles that cross the stop-line or pass through the junction when the traffic signal is red.

The following Traffic violations to be automatically detected by the system by using appropriate Non-Intrusive sensors technology by video analytics method to capture evidence image focused on the red light. The Evidence image should also be used for evidence snap generation

- (a) Red Light Violation
- (b) Stop Line Violation

The system shall capture the details of the violating vehicles on all lanes (expandable up to 6 lanes) of the approaches. Unmanned detection should be provided day and night. It should consist of the required number of ANPR grade cameras, and any other required equipment installed on the road, on a suitable gantry, cantilever pole or any other suitable structure (Capture Point Units) at designated and approved locations. However, the Contractor shall conduct the site survey and accordingly install the optimal number of cameras to full fill the

condition set forth in this RFP

The system shall be capable of detecting and capturing multiple infractions simultaneously in different lanes on each approach at any point of time. The system shall include an IR for nighttime operations. The RLVD sites shall have a UPS with battery backup for at least 180 minutes of uninterrupted operation during power outages. In case of TCP/IP connectivity failure to the control room, the RLVD system shall locally store evidence data and send it to the control room upon the resumption of connectivity. The system shall have necessary storage capacity to store evidence data for seven days locally.

The RLVD units shall be connected to the Central control room and RLVD back-office application shall run on centrally hosted servers with the ability of the control center staff to use the application. The system shall send the evidence information in an XML or other standard format keeping in mind the future extensibility and interoperability requirements. It should be possible for several such Capture Point Units to be connected to the same Central control room. The RLVD system shall capture evidence of violations that are legally admissible in court. The requirement shall have follows.

- (a) A perspective color photo of the violation clearly showing the vehicle jumping the red-light and the traffic signal colour,
- (b) A close-up high-quality (minimum 2 MP per lane or better) colour photo of the vehicle clearly showing the number plate of the vehicle in daytime and night
- (c) ANPR image of vehicle with clear number plate images and 2 evidence images.
- (d) A five second perspective video showing the violation event. The system shall display the site name, the approach name, the date, and the timestamp on the violation images. The RLVD back-office system shall be integrated with the e-challan system used by Chennai Traffic Police.
- (e) OCR accuracy should be at least 80% during daytime and 60% during nighttime for standard types of number plate.
- (f) Detection Zone for ANPR shall have the minimum 30m or more.
- (g) Integrated external infrared capable to take images in nighttime and automatically detect number plate at minimum 30m.
- (h) RLVD system to be configured such a way by which the allowed left or right turn during green signal not to be evaded.
- (i) All required analytics shall be executed at the LPU level for better performance.

5.1 RLVD Application

Table 5-1: Functional Requirement of RLVD Application

No.	Requirements
Centralized management	
1	■ The RLVD application shall be able to work as Management Client connected to the management server enables full remote system configuration of all servers, failover servers, devices, rules, schedules, and user rights.
Alarm Manager	

2	<ul style="list-style-type: none">■ RLVD central application shall be a single-point alarm function that provides a consolidated and clear overview of security and system-related alarms.■ A dedicated tab for the Alarm Manager shall be available in the RLVD application.■ RLVD application shall have an alarm list with extensive filtering capabilities and an alarming preview in both live and playback mode.■ Extensive alarm sort and filtering functions allow operators to focus on the most critical alarms.■ Instant preview of primary and related ANPR cameras helps reduce the number of false alarms.■ RLVD application shall have a tight integration with the map function allowing operators to indicate and acknowledge active alarms on the map.■ Alarm descriptions and work instructions make alarms actionable for operators.
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	<ul style="list-style-type: none"> ■ Alarm escalation and alarm forwarding possibilities allow operators with appropriate skills to handle different alarms. ■ RLVD application shall have alarm reports to enable incident documentation. ■ RLVD application shall have an alarm location map that presents the alarm operator with a map showing the alarm area when an alarm is selected. ■ RLVD application shall have the function of alarm notification to a single or a group of RLVD application users using Push Notifications. ■ Optional sound notifications for different alarm priorities for notification of new incoming alarms. ■ The alarm disabling option enables users to suppress alarms from a given device at a certain time. ■ Instant access to both live and recorded incident from the cameras that are related to the alarm handling reports give valuable information about alarm inflow and alarm handling performance
Centralized Search for End-user	
3	<ul style="list-style-type: none"> ■ RLVD application shall be able to be to search offense sequences, bookmarks, incidents, alarms, vehicles, people, locations, and events. ■ Dedicated tab for Centralized Search (replacing Sequence Explorer) ■ Visualize the location of Search results. ■ Save search templates including RLVD list and time scope. ■ Preview of selected search results with direct options for export of video, making bookmarks, exporting to pdf, and more formats. ■ Hide/show search results that are not matched on all search agents.
Metadata support & Storage	
4	<ul style="list-style-type: none"> ■ Received images & Videos need to be automatically saved in storage devices of including Location ID, camera ID and respective time, etc. The minimum storage time is 1 Year. Besides, the status of field equipment also saves ■ All data transmitted from the RLVD equipment and processed data in the CCC are recorded and stored for analysis and future usage. Data retrieval and presentation software should be provided that can easily retrieve and show the movie image and still image of the specified Incident at the hour or day. ■ Status of roadside equipment (normal or malfunctioned) should be recorded in the server as an operation log and for future reliability analysis together with error code and time stamp. ■ Each storage container is defined as a live database and one optional archive, where the video data, Images are moved from the live database to secondary disk systems or network drives. The archived data is still online and available for clients ■ Each evidence and incident data shall be available for the time period as required for judicial purpose.
Intuitive map function	
5	<ul style="list-style-type: none"> ■ RLVD application shall be able to show a Schematic Road map of the location. The map shall be Smart Map with intuitive map function with features given below: <ul style="list-style-type: none"> ○ Multi-layered and interactive maps display the location of every Junction and offer control of the entire RLVD system. It shall also have seamless drag-and-drop integration with a Smart video Wall. ○ Seamless geo-navigation supporting map services such as Bing, Google, and Open Street Maps as well as georeferenced GIS maps and CAD drawings, with drill-down possibilities to the classic maps. ○ Map images can be in standard graphic file formats including JPG, GIF, PNG, and TIF ○ Easy drag-and-drop and point-and-click definition of RLVD cameras, ANPR Camera servers. ○ Real-time status monitoring indication from all system components including cameras, I/O devices, and system servers
Evidence export	

6	<ul style="list-style-type: none"> RLVD central application shall be able to deliver authentic evidence to public authorities by exporting evidence to various formats, including video, images, vehicle numbers from multiple cameras in an encrypted format with dedicated player application included.
Integration options	
7	<ul style="list-style-type: none"> Supports display of MIP SDK plug-in items on the Smart Map The RLVD application shall be able to enable integrations to third-party Mobile or Web applications at the data level. Application's Driver Framework enables device manufacturers to develop their drivers for RLVD applications using their SDK.
Alerting and notification	
8	<ul style="list-style-type: none"> The system shall be able to show the live health status of each field component, sup components in the control center, and system shall be able to generate alert and display in the control room for the following status but not limited: <ul style="list-style-type: none"> Power status (Law power, UPS), Low battery alert, Cabinet door Open, Close Connectivity status Temperature status Camera status LPU alert etc
Logs	
9	<ul style="list-style-type: none"> RLVD application shall be able to show logging of system, audit, and rule entries to the management server with local caching during offline scenarios. Logs of system, audit, and rule entries are consolidated from all recording servers and clients. Each log file has the adjustable size and time limitations All the Logs from LPU to Server shall be synchronized and stored for audit purposes in sequence at least for 180 days
Operation Supporting	
10	<ul style="list-style-type: none"> Image zoom function for number plate and images should be provided. In case the number plate of the infracting vehicle is readable only through the magnifier then in such cases the printing should be possible along with the magnified image. The user interface should be user friendly and provide facility to user for viewing, sorting and printing violations. The software should also be capable of generating query based statistical reports on the violation data. The data provided for authentication of violations should be in an easy to use format as per the requirements of user. User should be provided with means of listing the invalid violations along with the reason(s) of invalidation without deleting the record(s). Basic image manipulation tools (zoom etc.) should be provided for the displayed image but the actual recorded image should never change. Log of user actions be maintained in read only mode. User should be provided with the password and ID to access the system along with user type (admin, user). Image should have a header/footer depicting the information about the site IP and violation details like date, time, equipment ID, location ID, Unique ID of each violation, lane number, Registration Number of violating vehicle and actual violation of violating vehicle etc. so that the complete lane wise junction behavior is recorded including (Red Light violation and Stop Line Violation). Number plate should be readable automatically by the software/interface. There should be user interface for simultaneous manual authentication / correction and saving Interface as well for taking prints of the violations (including image and above details). Red-light violation application should be capable of importing violation data for storage in database server which should also be available to the Operator for viewing and

	<p>retrieving the violation images and data for further processing. The program should allow for viewing, sorting, transfer & printing of violation data.</p> <ul style="list-style-type: none"> ■ Red-light violation application should generate the photograph of violations captured by the outstation system which include a wider view covering the violating vehicle with its surrounding and a close review indicating readable registration number plate patch of the violating vehicle or its web link on notices for court evidence. ■ All outstation units should be configurable using the software at the Central Location. ■ Violation retrieval could be sorted by date, time, location and vehicle registration number. It should also be possible to carry out recursive search and wild card search. ■ The system should have the functionality to export the violation evidence with water mark and encryption as per the techno-legal requirements. ■ The system should allow capturing multiple evidence snaps based on the time duration before, during and after the event. ■ The system should synchronize the evidence camera, ANPR camera and store the record in database with License plate image, image of the vehicle, and at least five snaps with short video showing clearly that the vehicle is crossing the red light / stop line while the signal is RED.
Safety Function	
11	<ul style="list-style-type: none"> ■ The system should have the capability to transfer the data to the CCC through proper encryption in real time and batch mode for verification of the infraction and processing of challan. Call forwarding architecture shall be followed to avoid any data loss during transfer. ■ If the connectivity to the CCC is not established due to network/connectivity failures, then all data pertaining to the infraction shall be stored on site and will be transferred once the connectivity is re-established automatically. There shall also be a facility of physical transfer of data on portable device whenever required. There should be a provision to store minimum one week of data at each site.
E-Challan Coordination	
12	<ul style="list-style-type: none"> ■ The RLVD system including ANPR capabilities should be integrated with the various application and databases like VAHAN/SARATHI, and e-Challan application (to be integrated under this project), etc. such that e-Challans can be generated by the system through an automated process. ■ The data shall be transferred to the CCC in real-time for verification and processing of E-challan. ■ The system shall be integrated with the RTO database/Vahan to fetch required information as per client requirements. ■ The system shall be configurable for bulk approval options for nondescript data. ■ The system shall be able to upload bulk data at the cloud/E-Challan server. ■ The system shall be able to track the entire life cycle of Challan from beginning to end (Offence Evidence, Generation, Authorize By, Penalty amount status, Challan status, etc.)
Security	
13	<ul style="list-style-type: none"> ■ Various users should be able to access the system using single sign-on and should be role based. Different roles which could be defined (to be finalized at the stage of implementation) could be Administrator, Supervisor, Officer, Operator, etc. ■ Apart from role-based access, the system should also be able to define access based on location. ■ Rights to different modules / Sub-Modules / Functionalities should be role based and proper log report should be maintained by the system for such access. ■ The architecture must adopt an end-to-end security model that protects data and the Infrastructure from malicious attacks, theft etc. Provisions for security of field equipment as well as protection of the software system from hackers and other threats shall be a part of the proposed system. ■ The evidence of infraction should be encrypted and protected so that any tampering can be detected.

	<ul style="list-style-type: none"> ■ Ease of configuration, ongoing health monitoring, and failure detection are vital to the goals of scalability, availability, and security and must be able to match the growth of the environment. ■ The system should have secure access mechanism for validation of authorized personnel. ■ Roles and Rights of users should be defined in the system as per the requirements of the Employer. ■ Deletion or addition and transfer of data should only be permitted to authorized users. ■ A log of all user activities should be maintained in the system.
Data Retrieval and Reports	
14	<ul style="list-style-type: none"> ■ The system shall enable easy and quick retrieval of snapshots (maximum 10 seconds) and other data for post incident analysis and investigations. Database search could be using criteria like date, time, location, and vehicle number. The system shall be able to generate suitable MIS reports as desired by the user. The system shall also provide advanced and smart searching facility of License plates from the database. ■ The system shall enable to correct or generate the vehicle number in Database after manual check of image.
Data Recording	
15	<ul style="list-style-type: none"> ■ All data pertain to the infraction shall be stored at least 1 year at server storage.

5.2 LPU (Local Processing Unit)

Table 5-2: Functional Requirement of LPU

No.	Requirements
General	
1	<ul style="list-style-type: none"> ■ The entire ANPR process shall be performed at the lane location in real-time. The information captured of the plate alphanumeric, datetime, and any other information required shall be completed in approximately a few milliseconds. This information shall be transmitted to the Control Room for further processing if necessary, and/or stored at the lane for later retrieval. ■ Violation retrieval could be sorted by date, time, location, and vehicle registration number. It should also be possible to carry out recursive search and wild card search. ■ The operator at the back office should be able to get an alarm of all fault(s) occurring at the camera site (e.g. sensor failure, camera failure, failure of linkage with traffic signal, connectivity failure, Camera tampering, sensor tampering).
Automatic Number Plate Recognition	
2	<ul style="list-style-type: none"> ■ The automatic number plate recognition Software will be part of the supplied system. The accuracy rate of ANPR will be taken as 80% or better during the daytime and 60% or better during the night-time on standard number plates. ■ A closer view indicating readable registration number plate patch of the violating vehicle for court evidence for each violation should be taken by an ANPR camera. ■ System should be able to recognize the entire event by which the same can be justified automatically by fetching the number plate of cars in violation. ■ Normal and Retro-reflective number plate capture: ANPR camera should be able to capture both “Retro reflective”, “Non-reflective” and “High Security” etc. type of number plates found in India
Lane Coverage	
3	<ul style="list-style-type: none"> ■ ANPR camera shall cover road width of 3.5 meter or 7 meter and above. ■ RLVD camera shall cover three (3) lanes and above.

Detection Speed	
4	<ul style="list-style-type: none"> ■ ANPR/RLVD cameras deployed should use fast electronic shutter (low exposure time) should be used to capture even vehicles moving at 100 km/h without any image blur. Frame rate should be sufficient to capture all violations and all vehicle ANPR video.
Vehicle violation criterion at Intersection	
5	<p>The system shall detect and capture vehicle details when:</p> <ul style="list-style-type: none"> ■ violates the stop line/zebra crossing ■ violates the red-light signal
System Mounting	
6	<ul style="list-style-type: none"> ■ System can be composite unit with all components inside the IP66 box or comprised of camera or other units mounted on poles or gantries with controller and processors at side poles to make sure all lanes of the road are covered.
IR Illuminator	
7	<ul style="list-style-type: none"> ■ Integrated external Infrared shall be capable to take images in nighttime and automatically detect number plate at distance of minimum 30 meters. The IR should be integrated with camera unit with single power source
Security	
8	<ul style="list-style-type: none"> ■ Standard Digital signature on each violation to assure data integrity. Strong encryption on data during local storage and data transfer to back office / Cloud storage.
Data Storage at site	
9	<ul style="list-style-type: none"> ■ The output of the OCR process and all captured images shall be stored on an industrial processing unit in the cabinet and also transmit to CCC. ■ If the connectivity to CCC is not established, then all data pertain to the infraction shall be stored at least 7 days on site and will be transferred once the connectivity is re-established automatically. If when the data storage reaches capacity, the image processor shall automatically over-write the oldest data.
10	<ul style="list-style-type: none"> ■ ALL vehicle ANPR capture system: The ANPR systems should also be capable of capturing number plate and images of all vehicles passing through the installed location. All vehicle images and numbers should be transmitted to control room and kept in database for post search for analysis purposes.
Alert Generation	
11	<ul style="list-style-type: none"> ■ System shall be able to show live health status of each field component, subcomponents in control center and system shall be able to generate alert and display in the control room for following status but not limited: <ul style="list-style-type: none"> a. Power status (Low power, UPS), b. Low battery alert, c. Cabinet door Open, Close d. Connectivity status e. Illuminator Status f. Temperature status g. Camera status h. LPU alert etc.
Traffic Violation Detection	
12	<ul style="list-style-type: none"> ■ Minimum following “RLVD Analytics” shall be part of the RLVD System. The Incident to be detected by the RLVD System shall be” Stop Line Violation”, “Red Light Violation”, “Automatic Number Plate Recognition”, ■ The following addon functionality shall be cover in the proposed solution but not limited to “No Helmet”, “Triple Riding”.” Wrong Way”, “Hot Listed”, “Blacklisted”, “Stolen vehicle” etc.

	<ul style="list-style-type: none"> ■ The system shall have the function to enter manually for an offense based on evidence collected by the RLVD system for further processing ■ Images zoom function for number plate and images should be provided. In case the number plate of the infracting vehicle is readable only through the magnifier then in such cases, the printing should be possible along with the magnified image. ■ The system shall be able to detect all vehicles infracting simultaneously in each lane/ arm at the junction as per locations provided. It should also be able to detect the vehicles infracting serially one after another in the same lane. The vehicles should be identifiable and demarcated in the image produced by the camera system. ■ The Evidence image produced by the system should be wide enough to give the exact position of the infracting vehicles concerning the stop line and indicate the color of the Traffic light at the instant of Infraction even if any other means are being used to report the color of the light. ■ Some exceptional cases will be considered for non-detection of “RLVD Analytics” such as. <ul style="list-style-type: none"> a. The number plate detection could not process due to overlapping of another vehicle, b. Over speeding vehicle, c. Non-Standard Number plate. d. Number plate cover by Mud or non-readable form necked eye’s e. Red Light Non-Functional or Malfunction but system shall have the functionality to track and update any such kind of alert on priority to authority and operator to register an incident. f. Any other case study observed during operation shall be considered by the Employer /Consultant/Authorities shall be considered in the non-detection exemption.
General	
13	<ul style="list-style-type: none"> ■ Entire functionalities define under this section shall be executed only at the LPU level and shall not be an effect due to communication interruption with Server

6 Hardware Requirement

All hardware equipment shall as a minimum, meet all the requirements listed in the specifications. The equipment’s provided shall accommodate to future technological advances which exceeds the minimum requirements provided in the specifications.

6.1 RLVD Camera (Overview Camera)

Table 6-1: Hardware Requirement of RLVD Camera (Overview Camera)

No.	Item	Specification
1.	Resolution	2MP or better, Minimum 1920 x 1080
2.	Image Sensor	Minimum 1/3” CCD/CMOS or better
3.	Framerate	min. 25/30 fps
4.	Shutter Speed	Auto/Manual: 1/50 to 1/10000 and above
5.	Lens	3-12.7 mm or better (required)
6.	Streams	Minimum 3 simultaneous H.264 and MJPEG streams
7.	Day night operation	Automatic removable IR cut filter
8.	Power	12 VDC or PoE IEEE 802.3af Class 1
9	Certification	The camera should be IP66 standards capable of withstanding vandalism and harsh weather conditions (certification to be produced) or better and Complete camera unit should have CE certificate and test certifications.

		Certification for box camera UL (Underwriters Laboratories) and BIS (Bureau of Indian Standards)
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6.2 ANPR Camera

Table 6-2: Hardware Requirement of ANPR Camera

No.	Item	Specification
1	Video Compression	H.264, H.265 or better
2	Video Resolution	2 MP or better
3	Frame rate	Min. 25 FPS
4	Image Sensor	1/ 2.8" Progressive Scan CCD / CMOS
5	Lens Type	Varifocal, C/CS Mount, IR Correction full HD lens
6	Shutter Speed	1/50 – 1/10,000 (25fps / 1 input)
7	Lens	5~50mm or suitable lenses to capture minimum 3.5 meters lane width from a minimum height of 6.5 meters or better
8	IR Cut Filter	Automatically Removable IR-cut filter
9	Day/Night Mode	Color, Mono, Auto
10	Region of Interest	4 zones (ON/OFF)
11	S/N Ratio	≥ 50 Db
12	WDR	120 dB
13	Stream	H.264, H.265 / H.265+ Triple & Individual Configurable, At least 1 stream at 2MP @ 25 FPS, Minimum 3 simultaneous
14	Streaming Method	Unicast, Multicast
15	Auto adjustment + Remote Control of Image settings	Colour, Brightness, sharpness, contrast, white balance, exposure control, backlight compensation, Gain Control, True Wide Dynamic Range
16	Local storage	Minimum 128 GB Memory card in a Memory card slot. In the event of failure of connectivity to the central server the camera shall record video locally on the SD card automatically to storage video at 2MP, 25 fps for minimum 7 days. After the connectivity is restored, these recordings shall be automatically merged with the server recording such that no manual intervention is required to transfer the SD card-based recordings to server. The SD storage shall be expandable up to 1TB.
17	Protocol	IPv4, IGMP, ICMP, ARP, TCP, UDP, DHCP, PPPoE, RTP, RTSP, RTCP, DNS, DDNS, NTP, FTP, UPnP, HTTP, HTTPS, SMTP, 802.1x, SNMP, QoS
18	Security	Password Protection, IP Address filtering, User Access Log, HTTPS Encryption
19	Operating conditions	As per city weather conditions
20	Casing	NEMA 4X / NEMA TS2 / IP-66 / IK10 rated
21	Alarm I/O	Minimum 2 Input & 1 / 2 Output contact for 3rd party integration
22	Video Interface	1 port (BNC) / Ethernet 1Vp-p, 75 Ohm
23	Certification	UL, EN, CE, FCC, BIS
24	ONVIF Compliance	The camera should be ONVIF Profile S & G Conformant for both present & future generation cameras of OEM

6.3 LPU (Local Processing Unit)

Table 6-3: Hardware Requirement of LPU

No.	Item	Specification
1.	CPU	Industrial or better
2.	Memory	2 GB DDR2/DDR3 RAM better
3.	Storage	minimum 1 TB SSD
4.	Network Adapter (NIC).	100 / 1000 base-t
5.	Others	The processor should be fanless type rated upto 70°

6.4 Network Infrastructure

The Contractor shall supply and install network equipment with necessary accessories at each location to connect each peripheral to the system. The Bidder shall supply and install all equipment, cables, connectors, terminals and other miscellaneous materials necessary to establish a working local area network connecting these systems.

The type and the number of the network equipment proposed by the Bidder as per the network design shall be mentioned by the Bidder in the BOQ. The network configuration shall be determined by the Bidder. The cost of the network devices and materials that is not explicitly listed in the BOQ of the Bid submitted by the Bidder or supplied by the Bidder during the installation works but deemed necessary for the system during any stage of this Contract shall be included in the cost of appropriate items and the Contract Price, and no separate payment shall be made.

6.5 Industrial Grade Layer -2 Switch

Table 6-4: Hardware requirement of Industrial grade Layer-2 switch

No.	Item	Requirements
1	Ethernet Interfaces	4 x 10/100/1000 Base-T PoE+ Ports auto-negotiation Plus 4 x 1000 Base-X SFP Uplink Slots (Should be loaded with 2 x 1G Single mode Industrial Grade Fiber Modules supports up to 10 Km)
2	Performance	Switching fabric 16 Gbps or more Forwarding rate 11.8 Mpps or more
3	PoE Budget	120 Watts
4	VLANs	512
5	Level 2 switching	IEEE 802.1, 802.3 standards, NTP, UDLD, LLDP, Unicast MAC filter, LACP, Private VLAN, Voice VLAN, VLAN double tagging (QinQ), STP, RSTP, MSTP, GARP, GMRP, GVRP, SNMPv1/v2c/v3, SNMP Inform, DHCP Server/Relay/Client, DHCP Option 66/67/82, BootP, RARP, TFTP, RMON, HTTP, HTTPS, Syslog, MRP (Client), LLDP, 802.1x, NetFlow/sFlow, port mirroring, Digital Diagnostic Monitoring (DDM)
6	Quality of Service (QoS)	Rate limit, auto QoS, ingress policing, egress queuing, and shaping
7	Multicast	IGMPv1, v2, v3 snooping, IGMP filtering, IGMP querier, MLD snooping v1, v2

8	Management	ICMP, Telnet, SSH, ARP, Syslog, SNMPv1/v2, RMON, SMTP, HTTP, HTTPS IPv4, IPv6
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9	Security	Port security, 802.1x, Dynamic VLAN assignment, Dynamic Host Configuration Protocol (DHCP) snooping, dynamic ARP inspection, IP Source Guard, storm control - unicast, multicast, broadcast, SSH, SNMPv3, TACACS+
10	Power Input Voltage	12 to 56 VDC with Redundant dual power inputs with 5-PIN Lockable Terminal Block Reverse Polarity Protection
11	Warranty	Min 5 years
12	Power Supply	Bidder should provide Industrial Grade AC/DC DIN RAIL power supply.

6.6 SFP Transceiver

Table 6-5: Hardware requirement of SFP transceiver

No	Item	Requirements
1	Media Type	Single-Mode or compatible with operator's network to be surveyed by bidder
2	Data Rate	1250 (Mbps)
3	Grade	Industrial

6.7 Din Rail Power Supply

Table 6-6: Hardware requirement of Din rail power supply

No	Item	Requirements
1	Input Voltage	180~240VAC
2	Input Frequency	50~60Hz
3	Output DC Voltage	48VDC±10%
4	Rated Current	2.5Amp
5	Current Range	0 ~ 5Amp
6	Rated Power	120W
7	Voltage Range	48~53VDC
8	Over-Voltage Protection	55~60VDC
9	Mounting Style	DIN Rail
10	Warranty	2 Years
11	Grade	Industrial

6.8 Gantry (U-Type)

Table 6-7: Hardware Requirement of Gantry (U-Type)

No.	Item Specification
1.	<ul style="list-style-type: none"> ■ The Contractor shall conduct the detailed design for the suitable gantry based on his/her site survey. ■ The minimum vertical clearance between the finished road surface and the bottom of the support structure/bottom of the Gantry shall be 6 m. ■ Required Informatory/guide sign as per IRC67 shall be mounted.

	<ul style="list-style-type: none"> ■ The structure for mounting of RLVD equipment and informatory/guide sign should be designed for wind speeds as per IS-875 part 3. ■ The mounting should be capable of withstanding roadside vibrations at site of installation.
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6.9 Cantilever (L-Type)

Table 6-8: Hardware Requirement of Cantilever (L-Type)

No.	Item Specification
1.	<ul style="list-style-type: none"> ■ The Contractor shall conduct the detailed design for the suitable cantilever based on his/her site survey. ■ The minimum vertical clearance between the finished road surface and the bottom of the support structure/bottom of the cantilever shall be 6 m. ■ Required Informatory/guide sign as per IRC67 shall be mounted. ■ The structure for mounting of RLVD equipment and informatory/guide sign should be designed for wind speeds as per IS-875 part 3. ■ The mounting should be capable of withstanding roadside vibrations at site of installation.

6.10 Power Supply and Outdoor UPS

Power supply and UPS shall be provided at each RLVD location. The Bidder shall present the calculation of power consumption and capacity of power supply system to be used for the RLVD system. The Bidder shall also consider the power requirement of network devices, wireless access points, switch, etc. suitably during the calculation. Proper earthing shall be provided at each equipment location.

The type and the number of the Power supply, Electric Meter proposed by the Bidder as per the design shall be mentioned by the Bidder in the BOQ. The cost of the Power Supply devices and materials that is not explicitly listed in the BOQ of the Bid submitted by the Bidder or supplied by the Bidder during the installation works but deemed necessary for the system during any stage of this Contract shall be included in the cost of appropriate items and the Contract Price, and no separate payment shall be made.

Table 6-9: Hardware Requirement of UPS

No.	Item	Requirements
1.	Input / Output Voltage	<ul style="list-style-type: none"> ■ AC 230 V / 50 Hz basically. ■ Output voltage: AC230V/50Hz ■ Commercial Power generally but with existing condition of power failure, instantaneous power failure and voltage fluctuation

2	UPS	<ul style="list-style-type: none"> ■ The UPS shall be of True online with double conversion topology. ■ The UPS shall work in outdoor environment to ensure all equipment's getting necessary power supply. No power surge. ■ The UPS unit shall have load level indicators that display the approximate electrical load placed upon the UPS. The UPS unit shall have a row of battery level indicators that display the approximate battery capacity. ■ The UPS unit shall have a minimum of the following as per OEM standard indicators: <ul style="list-style-type: none"> ➤ UPS Mode: On-line, Backup/Battery and Bypass; ➤ Over Load Indicator: This will display when UPS is running on overload;
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		<ul style="list-style-type: none"> ➤ Battery Status Indicator: This will illuminate when battery is low or faulty/disconnected; and ➤ System Fault: This will illuminate when there is some fault or interruption in UPS. ■ The UPS unit shall include Ethernet communication port to support remote management and monitoring capabilities using SNMP including alarm contacts and remote shutdown. Remote monitoring and testing software shall be included. The manufacturer shall provide all SNMP traps. ■ The UPS unit shall include automatic restart. Upon restoration of utility AC power after complete battery discharge, the UPS shall automatically restart and resume operation. ■ The UPS unit shall be compliant to IEC 62040-1, CE, IEC602040-2 safety standards. ■ The UPS and batteries shall be mounted in a separate cabinet & the enclosure shall be under lock & key, utilising the minimum possible space and arranged in an aesthetic manner. ■ Any field UPS system (as per MSI's design) shall be supplied with an environmentally rated cabinet for installation of the UPS and batteries. The cabinet shall have a rating of IP 55. The cabinet shall be supplied with in-built fans and proper ventilation as needed to ensure that the temperature inside the cabinet does not exceed 40 degrees C at any given point in time. ■ Backup time at least 3 hrs or more
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6.11 Cabinet

Table 6-10: Hardware Requirement of Cabinet

No.	Item Specification
1.	<ul style="list-style-type: none"> • The cabinet shall be electrically and mechanically robust and shall have a degree of protection of IP65 or higher specified in "IEC60529 Degrees of Protection Provided by Enclosures (IP Code)". • The cabinet shall have the provision for temperature controlling for optimal performance of equipment. • A right hinged door shall be provided on the front to realize easy maintenance work. The turning direction of the handle shall be counterclockwise. • The power supply including UPS shall be provided with a circuit breaker. • The anti-lightning and surge protection complying with the IEC61643-1 shall be provided. • Protection under/overvoltage condition shall be provided. • Monitoring status of temperature, battery and power supply • The cabinet shall be finished with the anticorrosive treatment • An internal lighting system • 220VAC plugs protected by a differential circuit breaker • An intercom jack • A file holder for the documentation • Standard key locks • Fixed on metallic cabinet frames (when false floor)

Table 7-1: Communication Requirements of RLVD

No.	Requirements
1.	<ul style="list-style-type: none">■ Communication between the roadside equipment of RLVD and the RLVD server at Chennai Traffic Information and Management Centre shall be wired connectivity provided by a single communication company, if required MPLS VPN shall be provided.■ The required bandwidth for RLVD to ensure the stable communication connectivity shall be proposed by the Contractor and subsequently approved by the Engineer.

8 Installation Requirement

The Contractor shall make the provision for necessary civil, foundation, earthing, necessary cable conducting, manhole, Power supply, redundant communication, new meter connection, quality, safety and last mile connectivity etc. to meet the functional requirement intended for the system. The Contractor shall obtain necessary permission from respective agency.

The Contractor shall make the provision of all types of necessary Road Marking to fulfill the SLA requirement during the project period. For greater efficiency of the RLVD system the necessary road marking (such as stop line, etc) shall be done on a regular interval of at least every six months or more as required.

The RLVD solution is installed on the gantry or cantilever structure at the intersection depending on the applicability of the solution. While all the RLVD cameras, ANPR cameras are placed downstream of the stop-line/Before stop line monitoring it from behind for better performance to match define SLA.

All the ANPR cameras and RLVD cameras shall be mounted on the gantry / cantilever with the required informatory and other signages board as per applicable standards and as indicted in the reference drawing. In any case, RLVD cameras shall be placed at a height of approximately 6 m. ANPR cameras shall be placed at a height of 6 m as well overlooking the traffic approach shall be enforced

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Chapter 2-8 Requirements of Automatic Traffic Counters-cum-classifier

1 General

The ATCC system includes two different types of Automatic Traffic Counter-cum-classifier (ATCC), i.e., ATCC- 1 and ATCC-2.

The primary purpose of ATCC-1 is to collect speed data for vehicles on Chennai Bypass and Outer Ring Road where the Operational frequency of MTC buses is minimal. Data collected by the system will be used to supplement the Probe System to calculate the congestion level on these roads. ATCC-1 will be installed on both directions of Chennai Bypass and Outer Ring Road at the identified locations. The ATCC-1 also collect traffic volume data categorized into different classes of vehicle on ORR & Chennai Bypass.

The primary purpose of ATCC-2 is to collect traffic volume data categorized into different classes of vehicles, on arterial roads all over Chennai City. The collected data will be accumulated and analyzed for road and traffic management purposes. They will be installed at mid-point locations between major junctions as well as collect speed of vehicles to provide information Probe System to calculate the congestion level on these roads.

The number of ATCC locations to be installed is:

ATCC-1: 86 units (on Chennai Bypass and Outer Ring Road at certain

intervals) ATCC-2: 144 units (at mid-point locations between major junctions

of arterial roads)

This is recommended as to be part of the implementation of this project (115 locations & 230 Numbers). This specification covers Automatic Traffic Counter-cum-Classifier (ATCC) system to be installed as one of the sub-systems of the Traffic Information System (TIS). The ATCC System shall be introduced to the Project with following objectives.

- (a) To understand the current traffic condition through the traffic volume and vehicle speed data at the predetermined locations within the city and including some designated locations on Inner Ring Road (IRR), Chennai Bypass Road, Outer Ring Road and National Highways.
- (b) To accumulate traffic condition data useful for traffic management and road planning
- (c) To measure large-sized vehicle traffic for planning of future pavement repair or other road facility maintenance
- (d) To share the measured and processed traffic information with road planning agencies, road administrators and traffic police for their use

2 System Configuration

The ATCC System shall consist of the following components:

ATCC Server in the DC:

ATCC roadside equipment consisting of image recognition type detector, processing unit, network equipment, power supply equipment and peripheral, Communication network between the ATCC Server and roadside equipment, and Supporting structure and foundation at site.

ATCC device installed in the project can be either a combined type or a separate type. The

combined type is the one where the image recognition detector and processing unit are supplied together as a single unit. The separate type is the one where the image recognition detector and processing unit are installed as separate components. The interface between the image recognition detectors and processing unit shall be compatible each other in whatever the ATCC device type is installed in the project.

No periodical manual adjustment shall be required for image recognition detector and processing unit.

The TIMS Command Control Centre shall have an ATCC Server for receiving pre-processed data from the ATCC roadside equipment. IP based network equipment shall be provided to connect the ATCC roadside equipment with the ATCC Server through wireless network or Fiber connectivity for better performance.

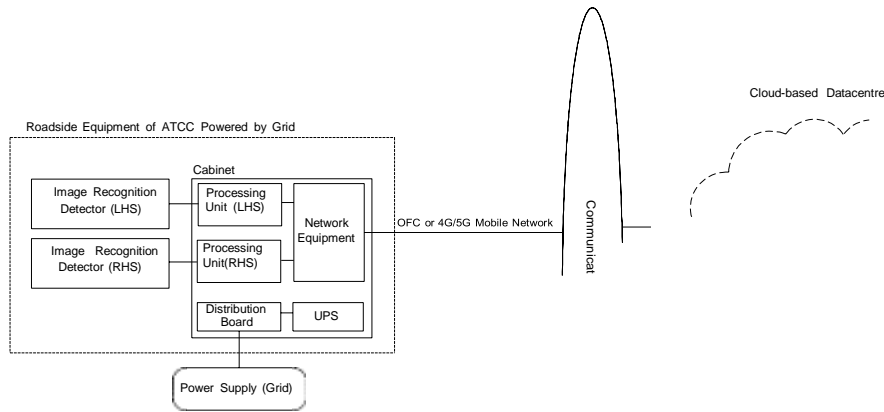


Figure 2-1: System Configuration of ATCC

3 Equipment Location and Type

The proposed locations for Automatic Traffic Counter and Classifier (ATCC) is shown below in the Table. The Contractor shall adhere to the proposed locations as much as possible to satisfy the above requirements. In case of any changes in the locations the Contractor shall get the written approval from the Engineer based on the alignment, geometry, viewing area (based on site visit).

Table 3-1: Target Locations of ATCC

No.	ATCC ID	Device ID	Latitude	Longitude	Location Description
1	ATCC 1	ATCC 1-1	13.1371201	79.9148150	NH 716 ,SI Nagar,Thiruvallur
2	ATCC 2	ATCC 1-2			
3	ATCC 3	ATCC 2-1	13.1265539	80.0123525	Church, Veppambaattu
4	ATCC 4	ATCC 2-2			
5	ATCC 5	ATCC 3-1	13.1186349	80.0887953	NH 716 ,Gandhi Nagar, Avadi
6	ATCC 6	ATCC 3-2			
7	ATCC 7	ATCC 4-1	13.1300571	80.1253971	Vaishnavi Nagar,Thirumullaivoyal
8	ATCC 8	ATCC 4-2			
9	ATCC 9	ATCC 5-1	13.0999400	80.1684800	NH 205 ,Sai nagar ,Ambattur ,Industrial Estate
10	ATCC 10	ATCC 5-2			
11	ATCC 11	ATCC 6-1	13.0900900	80.2288200	Palaiyam Nagar, Ayanavaram
12	ATCC 12	ATCC 6-2			
13	ATCC 13	ATCC 7-1	12.9631718	79.9469125	NH 48, Nenmeli, Sriperumbudur
14	ATCC 14	ATCC 7-2			
15	ATCC 15	ATCC 8-1	13.0247250	80.0241995	Madras Bombay Trunk Rd, Kuthambakkam
16	ATCC 16	ATCC 8-2			

17	ATCC 17	ATCC 9-1	13.0556418	80.0934580	Poonamallee Bypass Rd, Poonamallee
18	ATCC 18	ATCC 9-2			

No.	ATCC ID	Device ID	Latitude	Longitude	Location Description
19	ATCC 19	ATCC 10-1	13.0652344	80.1729256	Ponamallee High Road, Pallavan Nagar, Maduravoyal
20	ATCC 20	ATCC 10-2			
21	ATCC 21	ATCC 11-1	13.0750943	80.2167051	Ponamallee High Road, NSK Nagar, Arumbakkam
22	ATCC 22	ATCC 11-2			
23	ATCC 23	ATCC 12-1	13.0792000	80.2570800	Ponamallee High Road, Purasaiwakkam
24	ATCC 24	ATCC 12-2			
25	ATCC 25	ATCC 13-1	12.7840712	80.0135220	Karaivanar Street, Thellar Big St, Peramanur , Maraimalai Nagar
26	ATCC 26	ATCC 13-2			
27	ATCC 27	ATCC 14-1	12.8517094	80.0659531	Guduvanchery EB Office, Guduvanchery
28	ATCC 28	ATCC 14-2			
29	ATCC 29	ATCC 15-1	12.9045602	80.0943644	Rajamanickam St, Balaji Nagar, Tambaram East, New Perungalathur
30	ATCC 30	ATCC 15-2			
31	ATCC 31	ATCC 16-1	12.9389500	80.1294900	Kamaraj Nagar Tambaram Sanatorium
32	ATCC 32	ATCC 16-2			
33	ATCC 33	ATCC 17-1	12.9980900	80.1916900	Grand Southern Trunk Rd
34	ATCC 34	ATCC 17-2			
35	ATCC 35	ATCC 18-1	13.0170000	80.2250000	Anna Salai Road ,Saidapet Bridge
36	ATCC 36	ATCC 18-2			
37	ATCC 37	ATCC 19-1	13.3384581	80.1433989	Chennai Kolkata Hwy, Puduvoiyal
38	ATCC 38	ATCC 19-2			
39	ATCC 39	ATCC 20-1	13.2809000	80.1496900	SSS Complex, Panchetty NH-16
40	ATCC 40	ATCC 20-2			
41	ATCC 41	ATCC 21-1	13.1697100	80.1997700	46, GNT Rd, Kavankarai, Puzhal
42	ATCC 42	ATCC 21-2			
43	ATCC 43	ATCC 22-1	13.1499013	80.2129539	Chennai Kolkata Hwy, Retteri lake, Madhavaram
44	ATCC 44	ATCC 22-2			
45	ATCC 45	ATCC 23-1	13.1323200	80.2368500	Old Madhavaram Bus Depot, Mcetich Colony, Madhavaram
46	ATCC 46	ATCC 23-2			
47	ATCC 47	ATCC 24-1	13.2520407	80.2926704	Athipattu Main Rd, Athipattu Pudunagarr
48	ATCC 48	ATCC 24-2			
49	ATCC 49	ATCC 25-1	13.2154759	80.2721526	SH 104,
50	ATCC 50	ATCC 25-2			
51	ATCC 51	ATCC 26-1	13.1704165	80.3111301	SH 114, Jeevarathinam Nagar, Tiruvottiyur
52	ATCC 52	ATCC 26-2			
53	ATCC 53	ATCC 27-1	13.1601361	80.2705482	Chennai Petroleum Corporation Limited Manali
54	ATCC 54	ATCC 27-2			
55	ATCC 55	ATCC 28-1	13.1285812	80.2955441	Fishing Harbour ,Tondiarpet
56	ATCC 56	ATCC 28-2			
57	ATCC 57	ATCC 29-1	13.0812593	80.2884150	Secretariat, Chennai Port Trust , Fort St George
58	ATCC 58	ATCC 29-2			
59	ATCC 59	ATCC 30-1	13.0673200	80.2090100	72 A, Jawaharlal Nehru Rd, Vadapalani
60	ATCC 60	ATCC 30-2			
61	ATCC 61	ATCC 31-1	13.0909400	80.1985800	Pioneer Colony, Anna Nagar West Extension
62	ATCC 62	ATCC 31-2			
63	ATCC 63	ATCC 32-1	13.1274300	80.2091500	200 Feet Rd, Kannagi Nagar, Kolathur
64	ATCC 64	ATCC 32-2			
65	ATCC 65	ATCC 33-1	13.1676784	80.2297548	Inner Ring Rd, Assisi Nagar, Madhavaram, Mathur
66	ATCC 66	ATCC 33-2			
67	ATCC 67	ATCC 34-1	13.0619200	80.2829500	Kamarajar Promenade
68	ATCC 68	ATCC 34-2			
69	ATCC 69	ATCC 35-1	13.0225500	80.2718300	Dinakaran Salai
70	ATCC 70	ATCC 35-2			
71	ATCC 71	ATCC 36-1	12.9927300	80.2560500	

No.	ATCC ID	Device ID	Latitude	Longitude	Location Description
72	ATCC 72	ATCC 36-2			Indira Nagar, Adyar, Thiruvanmiyur
73	ATCC 73	ATCC 37-1	12.9361300	80.2523500	ECR
74	ATCC 74	ATCC 37-2			
75	ATCC 75	ATCC 38-1	12.8562100	80.2416200	Kanathur Reddykuppam
76	ATCC 76	ATCC 38-2			
77	ATCC 77	ATCC 39-1	12.7821500	80.2294400	Kelambakkam
78	ATCC 78	ATCC 39-2			
79	ATCC 79	ATCC 40-1	12.8550000	80.2260000	Semmancherry
80	ATCC 80	ATCC 40-2			
81	ATCC 81	ATCC 41-1	12.8011400	80.1958200	Vandalur- Kelambakkam Road , Pudupakkam
82	ATCC 82	ATCC 41-2			
83	ATCC 83	ATCC 42-1	12.8840127	80.1712996	MDR 633 Sithalapakkam
84	ATCC 84	ATCC 42-2			
85	ATCC 85	ATCC 43-1	12.8594012	80.1322835	Kelambakkam-Vandalur Rd, Rathinamangalam
86	ATCC 86	ATCC 43-2			
87	ATCC 87	ATCC 44-1	12.9001500	80.2345300	Ramaniyam Pushkar Phase 1, Kakaiginar Karunanidhi Slai, Sholinganallur
88	ATCC 88	ATCC 44-2			
89	ATCC 89	ATCC 45-1	12.9252900	80.2308200	Vivekananda Nagar, Karappakam
90	ATCC 90	ATCC 45-2			
91	ATCC 91	ATCC 46-1	12.9061400	80.2062900	Medavakkam, Kailash nagar
92	ATCC 92	ATCC 46-2			
93	ATCC 93	ATCC 47-1	12.9369300	80.2046900	Velachery-Tambaram Main Rd, Pallikaranai
94	ATCC 94	ATCC 47-2			
95	ATCC 95	ATCC 48-1	12.9189325	80.1745277	Velachery Main Rd, Santhosapuram Vengavasal
96	ATCC 96	ATCC 48-2			
97	ATCC 97	ATCC 49-1	12.9620000	80.2460000	Old Mahabalipuram Rd
98	ATCC 98	ATCC 49-2			
99	ATCC 99	ATCC 50-1	12.9497203	80.2269481	SH109, Pallikaranai , Pallikaranai
100	ATCC 100	ATCC 50-2			
101	ATCC 101	ATCC 51-1	12.9610600	80.2149300	Velachery Rd
102	ATCC 102	ATCC 51-2			
103	ATCC 103	ATCC 52-1	12.9500000	80.1800000	Pallavaram-Thuraipakkam Rd
104	ATCC 104	ATCC 52-2			
105	ATCC 105	ATCC 53-1	12.9724797	80.1390113	Pammal Main Rd, Krishna Nagar, Muthamizh Nagar, Pammal
106	ATCC 106	ATCC 53-2			
107	ATCC 107	ATCC 54-1	13.0247528	80.1088646	Jaya Nagar, Mangadu
108	ATCC 108	ATCC 54-2			
109	ATCC 109	ATCC 55-1	12.9813400	80.2417900	Mahatma Gandhi Nagar, Taramani Link Road
110	ATCC 110	ATCC 55-2			
111	ATCC 111	ATCC 56-1	12.9975400	80.2164700	Velachery Main Rd
112	ATCC 112	ATCC 56-2			
113	ATCC 113	ATCC 57-1	13.0080000	80.2340000	Sardar Patel Rd
114	ATCC 114	ATCC 57-2			
115	ATCC 115	ATCC 58-1	13.0173400	80.1884800	Mount Poonamallee high Road
116	ATCC 116	ATCC 58-2			
117	ATCC 117	ATCC 59-1	13.0393600	80.1320900	Mount Poonamallee high Road, Kattupakkam
118	ATCC 118	ATCC 59-2			
119	ATCC 119	ATCC 60-1	13.0483614	80.1078896	Mount Poonamallee Road , Ayyappanthangal , Karayanchavadi
120	ATCC 120	ATCC 60-2			
121	ATCC 121	ATCC 61-1	13.0447600	80.2630500	Dr.Radha Krishnan Salai, Kattukoil Garden,Mylapore
122	ATCC 122	ATCC 61-2			

No.	ATCC ID	Device ID	Latitude	Longitude	Location Description
123	ATCC 123	ATCC 62-1	13.0623400	80.2449700	Thousand Lights West
124	ATCC 124	ATCC 62-2			
125	ATCC 125	ATCC 63-1	13.0538700	80.2266000	Arcot Road, United India Colony, Kodambakkam
126	ATCC 126	ATCC 63-2			
127	ATCC 127	ATCC 64-1	13.1640553	80.0991952	MDR575, Bharathi Nagar, New Vellanyr
128	ATCC 128	ATCC 64-2			
129	ATCC 129	ATCC 65-1	12.9766100	80.0506000	Kundrathur-Sripreambudur
130	ATCC 130	ATCC 65-2			
131	ATCC 131	ATCC 66-1	12.9239700	80.0145900	Manimanglam Road SH 110
132	ATCC 132	ATCC 66-2			
133	ATCC 133	ATCC 67-1	12.8556000	80.1995400	Karanai Main Road
134	ATCC 134	ATCC 67-2			
135	ATCC 135	ATCC 68-1	13.0546400	80.2540500	Nagapattinam Chennai Hwy Road-Mount Road
136	ATCC 136	ATCC 68-2			
137	ATCC 137	ATCC 69-1	13.0358400	80.2122800	Grand Southern Tunk Road
138	ATCC 138	ATCC 69-2			
139	ATCC 139	ATCC 70-1	13.0620900	80.2364400	Tank Bund Road
140	ATCC 140	ATCC 70-2			
141	ATCC 141	ATCC 71-1	13.0271000	80.2568100	2 nd Main Road
142	ATCC 142	ATCC 71-2			
143	ATCC 143	ATCC 72-1	13.0460700	80.1880400	Arcot Road
144	ATCC 144	ATCC 72-2			
145	ATCC 145	ATCC 73-1	12.9182118	80.1013776	NH32-Chennai By-Pass
146	ATCC 146	ATCC 73-2			
147	ATCC 147	ATCC 74-1	12.9568900	80.1194700	NH32-Chennai By-Pass
148	ATCC 148	ATCC 74-2			
149	ATCC 149	ATCC 75-1	12.9961000	80.1229500	NH32-Chennai By-Pass
150	ATCC 150	ATCC 75-2			
151	ATCC 151	ATCC 76-1	13.0464681	80.1497506	NH32-Chennai By-Pass
152	ATCC 152	ATCC 76-2			
153	ATCC 153	ATCC 77-1	13.0571939	80.1597472	NH32-Chennai By-Pass
154	ATCC 154	ATCC 77-2			
155	ATCC 155	ATCC 78-1	13.0736171	80.1610064	NH32-Chennai By-Pass
156	ATCC 156	ATCC 78-2			
157	ATCC 157	ATCC 79-1	13.0921998	80.1614585	NH32-Chennai By-Pass
158	ATCC 158	ATCC 79-2			
159	ATCC 159	ATCC 80-1	13.1098626	80.1636040	NH32-Chennai By-Pass
160	ATCC 160	ATCC 80-2			
161	ATCC 161	ATCC 81-1	13.1267243	80.1684746	NH32-Chennai By-Pass
162	ATCC 162	ATCC 81-2			
163	ATCC 163	ATCC 82-1	13.1375592	80.1845840	NH32-Chennai By-Pass
164	ATCC 164	ATCC 82-2			
165	ATCC 165	ATCC 83-1	13.1458256	80.1963684	NH32-Chennai By-Pass
166	ATCC 166	ATCC 83-2			
167	ATCC 167	ATCC 84-1	12.8830500	80.0813700	Chennai Outer Ring Road
168	ATCC 168	ATCC 84-2			
169	ATCC 169	ATCC 85-1	12.8971100	80.0703000	Chennai Outer Ring Road
170	ATCC 170	ATCC 85-2			
171	ATCC 171	ATCC 86-1	12.9166900	80.0753200	Chennai Outer Ring Road
172	ATCC 172	ATCC 86-2			
173	ATCC 173	ATCC 87-1	12.9344300	80.0814200	Chennai Outer Ring Road
174	ATCC 174	ATCC 87-2			
175	ATCC 175	ATCC 88-1	12.9513400	80.0877500	Chennai Outer Ring Road
176	ATCC 176	ATCC 88-2			

No.	ATCC ID	Device ID	Latitude	Longitude	Location Description
177	ATCC 177	ATCC 89-1	12.9694900	80.0897800	Chennai Outer Ring Road
178	ATCC 178	ATCC 89-2			
179	ATCC 179	ATCC 90-1	12.9877100	80.0891000	Chennai Outer Ring Road
180	ATCC 180	ATCC 90-2			
181	ATCC 181	ATCC 91-1	13.0032400	80.0894100	Chennai Outer Ring Road
182	ATCC 182	ATCC 91-2			
183	ATCC 183	ATCC 92-1	13.0202200	80.0937100	Chennai Outer Ring Road
184	ATCC 184	ATCC 92-2			
185	ATCC 185	ATCC 93-1	13.0383700	80.0870200	Chennai Outer Ring Road
186	ATCC 186	ATCC 93-2			
187	ATCC 187	ATCC 94-1	13.0549400	80.0811400	Chennai Outer Ring Road
188	ATCC 188	ATCC 94-2			
189	ATCC 189	ATCC 95-1	13.0704900	80.0711000	Chennai Outer Ring Road
190	ATCC 190	ATCC 95-2			
191	ATCC 191	ATCC 96-1	13.0824100	80.0631300	Chennai Outer Ring Road
192	ATCC 192	ATCC 96-2			
193	ATCC 193	ATCC 97-1	13.0965500	80.0521600	Chennai Outer Ring Road
194	ATCC 194	ATCC 97-2			
195	ATCC 195	ATCC 98-1	13.1133900	80.0519200	Chennai Outer Ring Road
196	ATCC 196	ATCC 98-2			
197	ATCC 197	ATCC 99-1	13.1319500	80.0526000	Chennai Outer Ring Road
198	ATCC 198	ATCC 99-2			
199	ATCC 199	ATCC 100-1	13.1512700	80.0548800	Chennai Outer Ring Road
200	ATCC 200	ATCC 100-2			
201	ATCC 201	ATCC 101-1	13.1655400	80.0657600	Chennai Outer Ring Road
202	ATCC 202	ATCC 101-2			
203	ATCC 203	ATCC 102-1	13.1765400	80.0791400	Chennai Outer Ring Road
204	ATCC 204	ATCC 102-2			
205	ATCC 205	ATCC 103-1	13.1790800	80.0976600	Chennai Outer Ring Road
206	ATCC 206	ATCC 103-2			
207	ATCC 207	ATCC 104-1	13.1816800	80.1158600	Chennai Outer Ring Road
208	ATCC 208	ATCC 104-2			
209	ATCC 209	ATCC 105-1	13.1790600	80.1342700	Chennai Outer Ring Road
210	ATCC 210	ATCC 105-2			
211	ATCC 211	ATCC 106-1	13.1870100	80.1492800	Chennai Outer Ring Road
212	ATCC 212	ATCC 106-2			
213	ATCC 213	ATCC 107-1	13.2020600	80.1595100	Chennai Outer Ring Road
214	ATCC 214	ATCC 107-2			
215	ATCC 215	ATCC 108-1	13.2155800	80.1760300	Chennai Outer Ring Road
216	ATCC 216	ATCC 108-2			
217	ATCC 217	ATCC 109-1	13.2201100	80.1867000	Chennai Outer Ring Road
218	ATCC 218	ATCC 109-2			
219	ATCC 219	ATCC 110-1	13.2291100	80.2038900	Chennai Outer Ring Road
220	ATCC 220	ATCC 110-2			
221	ATCC 221	ATCC 111-1	13.2393300	80.2194300	Chennai Outer Ring Road
222	ATCC 222	ATCC 111-2			
223	ATCC 223	ATCC 112-1	13.2516000	80.2351800	Chennai Outer Ring Road
224	ATCC 224	ATCC 112-2			
225	ATCC 225	ATCC 113-1	13.2648700	80.2469900	Chennai Outer Ring Road
226	ATCC 226	ATCC 113-2			
227	ATCC 227	ATCC 114-1	13.2695000	80.2618200	Chennai Outer Ring Road
228	ATCC 228	ATCC 114-2			
229	ATCC 229	ATCC 115-1	13.2791600	80.2601700	Chennai Outer Ring Road to Minjur
230	ATCC 230	ATCC 115-2			

4 System Functional Requirement

The ATCC-1 and ATCC-2 hall have the functionalities described below.

Table 4-1: Functional Requirement of ATCC Application

No.	Requirements									
Vehicle Detection and Counting Function										
1.	<p>The ATCC roadside equipment shall continuously take the image of the road area covered. It shall be possible to adjust the angle and coverage area of the image recognition detector to maximize the detection accuracy.</p> <p>Images taken by the ATCC equipment shall be processed to obtain the required traffic data. The processing unit shall be capable of:</p> <ul style="list-style-type: none">■ Detecting all types of vehicle including auto rickshaw moving in any direction and recognize the shape or edge of the vehicle.■ Counting the number of vehicles that pass the sensing area during the unit measurement time.■ For ATCC-1, classifying the vehicle into large and small size vehicle shall be required. The definition of the large and small size shall be made according to the vehicle length and the classification parameter shall be adjustable.■ For ATCC-2, classifying the vehicle into Truck, Bus, Sedan, Subcompact Car and Auto-Rickshaw as a minimum classification shall be required. The definition of the large and small size shall be made according to the vehicle length and the classification parameter shall be adjustable.■ Calculating an average speed per unit time which is the arithmetic average of the speed of vehicles that have passed the sensing area during one-unit measurement time.■ The ATCC system is expected to have 92% for vehicle counting accuracy and 85% for vehicle classification accuracy. Contractor shall propose the counting accuracy to be guaranteed.■ Unit duration of detection, measurement and calculation shall be one (1) minute time interval.									
Data Processing Function										
2.	<p>The ATCC roadside equipment shall process the vehicle detection data and produce the following data:</p> <ul style="list-style-type: none">■ One-minute traffic volume■ One minute large-sized vehicle volume■ One-minute arithmetic average speed									
Data Transmission Function										
3.	<p>The ATCC roadside equipment shall send the processed data to the ATCC Server in TIMS Command Control Centre along with the equipment status at one-minute interval. The data transmission timing shall use the internal timer of the roadside equipment.</p> <table><tr><th>Sub-system</th><th>Types of Data</th><th>Interval</th></tr><tr><td rowspan="4">ATCC System</td><td>Traffic volume (all types)</td><td rowspan="4">One (1) minute</td></tr><tr><td>Traffic volume (large)</td></tr><tr><td>Average speed</td></tr><tr><td>Equipment operational status</td></tr></table>	Sub-system	Types of Data	Interval	ATCC System	Traffic volume (all types)	One (1) minute	Traffic volume (large)	Average speed	Equipment operational status
Sub-system	Types of Data	Interval								
ATCC System	Traffic volume (all types)	One (1) minute								
	Traffic volume (large)									
	Average speed									
	Equipment operational status									
Error Checking Function										

4.	The data sent from the roadside equipment shall be tested first for possible errors. The thresholds shall be defined, and data received from the roadside equipment shall be checked with the threshold. If a data is judged as abnormal, the equipment shall be marked as marginal. If marginal data continues consecutively for the specified number of times, the equipment shall be marked as malfunctioned. Likewise, if error signal is sent from ATCC roadside equipment, it shall be marked malfunctioned, and an alarm shall be issued to the Operator Console. The
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	<p>faulty detector shall be recorded in the operation log. The data judged as abnormal shall not be used for further processing.</p> <p>The data from the vehicle detector marked as malfunctioned shall be checked continuously for data abnormality. If data is judged normal, normal processing of the data shall resume automatically.</p>																															
Data Processing Function																																
5.	<p>The ATCC Server shall process the one-minute traffic data collected into five (5) minute data. Traffic volume shall be the sum of the latest five one-minute data and speed data shall be the arithmetic average of the latest five one-minute data.</p> <p>Five-minute traffic volume data shall be accumulated into one-hour traffic volume data and one-hour data shall be accumulated into 24-hour traffic volume data. No further processing is required for the average speed data longer than five-minute data.</p>																															
Data storage and retrieval function																																
6	<p>All processed data shall be stored in the ATCC server and then TIMS Server for analysis and future usage. In addition, status of ATCC roadside equipment (normal or malfunctioned) shall be recorded in the ATCC Server as operation log with error code and time stamp for future reliability analysis. Data retrieval and presentation software shall be provided to show the historical traffic flow data and operating condition of the specified roadside equipment location at the specified time, hour or day. Graphical presentation of historical traffic flow data such as hourly variation and daily variation shall also be considered.</p> <p>The processed traffic volume information is aggregated for 1 hour, day, month and saved for a certain period (over 1 year) file. Data older than the retention period shall be deleted in order from the oldest and old data can be saved in the storage device etc. of the TIMS Server. In addition to the above data, it also stores information necessary for system operation. It is assumed that the saved information can be output (MS Excel etc.) from the operator console.</p> <table><tr><th>Sub-System</th><th>Data</th><th>Interval/Timing</th></tr><tr><td rowspan="4">ATCC System</td><td>Traffic volume (all types)</td><td>5 minutes / 1hour/ 24 hours</td></tr><tr><td>Traffic volume (large)</td><td>5 minutes / 1hour/ 24 hours</td></tr><tr><td>Average speed</td><td>5 minutes</td></tr><tr><td>Equipment status</td><td>Upon status change</td></tr></table>	Sub-System	Data	Interval/Timing	ATCC System	Traffic volume (all types)	5 minutes / 1hour/ 24 hours	Traffic volume (large)	5 minutes / 1hour/ 24 hours	Average speed	5 minutes	Equipment status	Upon status change																			
Sub-System	Data	Interval/Timing																														
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	Traffic volume (large)	5 minutes / 1hour/ 24 hours																														
	Average speed	5 minutes																														
	Equipment status	Upon status change																														
Screen Display Function																																
7	<p>The information display shall be schematic map-based interface and as well in the form of a list. The schematic map-based display shall cover the entire selected area and be able to enlarge individual locations on the map when selected. The enlarged view shall be able to display the details for each selected location. The details displayed shall cover not be limited, the contents described in the Table below.</p> <table><tr><th>Item</th><th>Contents on Schematic Map</th><th>Graphic</th><th>List</th></tr><tr><td>Equipment location and status</td><td>Location of ATCC roadside equipment and its status (normal / malfunctioned)</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr><tr><td rowspan="4">Current traffic volume</td><td>One (1) minute volume (all/large)</td><td></td><td><input type="checkbox"/></td></tr><tr><td>One (1) minute average speed</td><td></td><td></td></tr><tr><td>Five (5) minute volume (all type/large)</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr><tr><td>Five (5) minute average speed</td><td></td><td></td></tr><tr><td rowspan="3">Historical traffic volume</td><td>Five (5) minute volume (all type/large) variation</td><td></td><td></td></tr><tr><td>Five (5) minute speed variation</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr><tr><td>Hourly traffic volume variation (all type /large)</td><td></td><td></td></tr></table>	Item	Contents on Schematic Map	Graphic	List	Equipment location and status	Location of ATCC roadside equipment and its status (normal / malfunctioned)	<input type="checkbox"/>	<input type="checkbox"/>	Current traffic volume	One (1) minute volume (all/large)		<input type="checkbox"/>	One (1) minute average speed			Five (5) minute volume (all type/large)	<input type="checkbox"/>	<input type="checkbox"/>	Five (5) minute average speed			Historical traffic volume	Five (5) minute volume (all type/large) variation			Five (5) minute speed variation	<input type="checkbox"/>	<input type="checkbox"/>	Hourly traffic volume variation (all type /large)		
Item	Contents on Schematic Map	Graphic	List																													
Equipment location and status	Location of ATCC roadside equipment and its status (normal / malfunctioned)	<input type="checkbox"/>	<input type="checkbox"/>																													
Current traffic volume	One (1) minute volume (all/large)		<input type="checkbox"/>																													
	One (1) minute average speed																															
	Five (5) minute volume (all type/large)	<input type="checkbox"/>	<input type="checkbox"/>																													
	Five (5) minute average speed																															
Historical traffic volume	Five (5) minute volume (all type/large) variation																															
	Five (5) minute speed variation	<input type="checkbox"/>	<input type="checkbox"/>																													
	Hourly traffic volume variation (all type /large)																															

	Health Status & Alert	Door Open, close, Power status on UPS or Row, subcomponents health status etc.	<input type="checkbox"/>	<input type="checkbox"/>
	Operation log	Error log (date and time of failure and recovery)		<input type="checkbox"/>
	Parameter	Parameters for viewing and editing		<input type="checkbox"/>
Reporting Function				
8	The ATCC Server shall have the reporting function as described hereunder. The reports shall be generated as per the schedule or upon the system operator's request. It shall be possible to generate the report as a file in portable document file format.			
	Item	Contents		
	Traffic volume	Daily report of hourly traffic volume (all type and large vehicle) Monthly report of daily traffic volume by vehicle class (all type and large vehicle)		
	Operation and error log	Status (normal / malfunctioned) of roadside equipment Error record (showing date and time of failure and recovery)		
Alert Function				
9	<ul style="list-style-type: none">System shall be able to show live health status of each field component, sup components in control center and system shall be able to generate alert and display in the control room for following status but not limited:<ul style="list-style-type: none">a. Power status (Law power, UPS),b. Low battery alert,c. Cabinet door Open, Closed. Connectivity statuse. Temperature statusf. Image processing unit statusg. LPU alert etc.			
Data Storage at site				
	<ul style="list-style-type: none">The analyzed data of ATCC at the site shall be stored on an industrial processing unit in the cabinet and also transmit to CCC.If the connectivity to CCC is not established, then all data pertain to the infraction shall be stored at least 7 days on site and will be transferred once the connectivity is re-established automatically. If when the data storage reaches capacity, the image processor shall automatically over-write the oldest data.			
Others				
9	<ul style="list-style-type: none">The ATCC System shall measure the traffic flow data listed below at the locations specified. The unit duration of measurement, detection, identification and calculation shall be within one (1) minute interval.<ul style="list-style-type: none">√ Volume of all types of vehicle (Truck, BUS, Sedan, Subcompact Car, Auto-Rickshaw etc.)√ Vehicle SpeedThe system shall process the data measured and the measurement location.The ATCC System shall produce sufficiently accurate traffic condition data even under complex traffic and road conditions in and around Chennai.The traffic data shall be transmitted to the TIMS Command Control Centre at specified interval and the data shall be stored for a certain period.Image recognition type ATCC equipment shall be adopted, and it shall detect vehicles on multiple lanes of traffic.The detection target of ATCC shall be vehicles passing through the sensor area at a speed not less than 1 km/h and not more than 160 km/h.The ATCC system is expected to have 92% for vehicle counting accuracy and 85% for vehicle classification accuracy.The Contractor shall state the accuracy of ATCC that he proposes together with supporting data in his technical proposal.			

	<ul style="list-style-type: none"> ■ The ATCC system shall be share required data with other ITS components as well as Servers. ■ The ATCC system shall maintain the communication log/acknowledgment for data exchange with other systems. ■ All the maintenance, SLA, Inventory, fault related activity for ATCC system shall be automated, manageable, trackable through CCC. ■ The Contractor shall demonstrate the accuracy proposed in his technical proposal under the test conditions defined by the Engineer during technical evaluation ■ The following vehicles and conditions shall be excluded for measurement <ul style="list-style-type: none"> ✓ Vehicles running in the opposite direction ✓ Hidden vehicles due to overlapping with the vehicles in front.
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5 Hardware Requirement

All hardware equipment shall as a minimum, meet all the requirements listed in the specifications. The equipment's provided shall accommodate to future technological advances which exceeds the minimum requirements provided in the specifications.

5.1 Image Recognition Detector and Processing Unit

Table 5-1: Hardware Requirement of Image Recognition Detector and Processing Unit

No.	Item	Specifications
1.	Imaging device	CCD or MOS or CMOS
2.	Effective pixels	640(H) x 480(V) or more
3.	Resolution	VGA: 640 x 480 or more
4.	Image distribution	MPEG-4 / H.264, JPEG
5.	Frame rate	25 fps or more
6.	Detected data	<ul style="list-style-type: none"> ■ Traffic volume (Large vehicle/Small vehicle) ■ Vehicle Speed
7.	Transmitting Period	1 Minutes
8.	LAN Interface	10BASE-T/100BASE-TX (RJ-45) x 1 port
9.	Power Requirements	AC220-240V, 50Hz Backup power supply: UPS with 15 minutes backup
10.	Power Consumption	100 VA or less
11.	Operating Temperature	0 to +70 degrees Celsius
12.	Degrees of Protection	Image Recognition Detector: IP67 or more
13.	Lightning-induced surge protection	IEC 61643-1 Class II or better
14.	Reliability and maintainability	MTBF: 30,000 hours MTTR: 0.5 hours

5.2 LPU(Local Processing Unit)

Table 5-2: Hardware requirement of Local Processing Unit

No.	Item	Specification
1.	CPU	Industrial or better
2.	Memory	2 GB DDR2/DDR3 RAM better

No.	Item	Specification
3.	Storage	minimum 1 TB SSD
4.	Network Adapter (NIC).	100 / 1000 base-t
5.	Others	The processor should be fanless type rated upto 70°

5.3 Network Infrastructure

The Contractor shall supply and install network equipment at each location to connect each peripheral to the system. The Bidder shall supply and install all equipment, cables, connectors, terminals and other miscellaneous materials necessary to establish a working local area network connecting these systems. The network between the Control Centre and sub-systems shall either use the optical fibre cable network or high-end Wireless Access Points along the Project Area and a data communication network shall be established using layered switches to be supplied by the Contractor.

The type and the number of the network equipment proposed by the Bidder as per the network design shall be mentioned by the Bidder in the BOQ. The network configuration shall be determined by the Bidder. The cost of the network devices and materials that is not explicitly listed in the BOQ of the Bid submitted by the Bidder or supplied by the Bidder during the installation works but deemed necessary for the system during any stage of this Contract shall be included in the cost of appropriate items and the Contract Price, and no separate payment shall be made.

5.4 Industrial Grade Layer -2 Switch

Table 5-3: Hardware requirement of Industrial grade Layer-2 switch

No.	Item	Requirements
1	Ethernet Interfaces	4 x 10/100/1000 Base-T PoE+ Ports auto-negotiation Plus 4 x 1000 Base-X SFP Uplink Slots (Should be loaded with 2 x 1G Single mode Industrial Grade Fiber Modules supports up to 10 Km)
2	Performance	Switching fabric 16 Gbps or more Forwarding rate 11.8 Mpps or more
3	PoE Budget	120 Watts
4	VLANS	512
5	Level 2 switching	IEEE 802.1, 802.3 standards, NTP, UDLD, LLDP, Unicast MAC filter, LACP, Private VLAN, Voice VLAN, VLAN double tagging (QinQ), STP, RSTP, MSTP, GARP, GMRP, GVRP, SNMPv1/v2c/v3, SNMP Inform, DHCP Server/Relay/Client, DHCP Option 66/67/82, BootP, RARP, TFTP, RMON, HTTP, HTTPS, Syslog, MRP (Client), LLDP, 802.1x, NetFlow/sFlow, port mirroring, Digital Diagnostic Monitoring (DDM)
6	Quality of Service (QoS)	Rate limit, auto QoS, ingress policing, egress queuing, and shaping
7	Multicast	IGMPv1, v2, v3 snooping, IGMP filtering, IGMP querier, MLD snooping v1, v2
8	Management	ICMP, Telnet, SSH, ARP, Syslog, SNMPv1/v2, RMON, SMTP, HTTP, HTTPS IPv4, IPv6
9	Security	Port security, 802.1x, Dynamic VLAN assignment, Dynamic Host Configuration Protocol (DHCP) snooping, dynamic ARP inspection, IP Source Guard, storm control - unicast, multicast, broadcast, SSH, SNMPv3, TACACS+

10	Power Input Voltage	12 to 56 VDC with Redundant dual power inputs with 5-PIN Lockable Terminal Block
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No.	Item	Requirements
		Reverse Polarity Protection
11	Warranty	Min 5 years
12	Power Supply	Bidder should provide Industrial Grade AC/DC DIN RAIL power supply.

5.5 SFP Transceiver

Table 5-4: Hardware requirement of SFP transceiver

No	Item	Requirements
1	Media Type	Single-Mode or compatible with operator's network to be surveyed by bidder
2	Data Rate	1250 (Mbps)
3	Grade	Industrial

5.6 Din Rail Power Supply

Table 5-5: Hardware requirement of Din rail power supply

No	Item	Requirements
1	Input Voltage	180~240VAC
2	Input Frequency	50~60Hz
3	Output DC Voltage	48VDC \pm 10%
4	Rated Current	2.5Amp
5	Current Range	0 ~ 5Amp
6	Rated Power	120W
7	Voltage Range	48~53VDC
8	Over-Voltage Protection	55~60VDC
9	Mounting Style	DIN Rail
10	Warranty	2 Years
11	Grade	Industrial

5.7 Power Supply and Outdoor UPS

Power supply and UPS shall be provided at each ATCC location. The Bidder shall present the calculation of power consumption and capacity of power supply system to be used for the ATCC. The Bidder shall also consider the power requirement of network devices, wireless access points, switch, etc. suitably during the calculation. Proper earthing shall be provided at each equipment location.

The type and the number of the Power supply, Electric Meter proposed by the Bidder as per the design shall be mentioned by the Bidder in the BOQ. The cost of the Power Supply devices and materials that is not explicitly listed in the BOQ of the Bid submitted by the Bidder or supplied by the Bidder during the installation works but deemed necessary for the system during any stage of this Contract shall be included in the cost of appropriate items and the Contract Price, and no separate payment shall be made.

Table 5-6: Hardware Requirement of Outdoor UPS

No.	Item	Requirements
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1.	Input / Output Voltage	<ul style="list-style-type: none"> ■ AC 230 V / 50 Hz basically. ■ Output voltage: AC230V/50Hz ■ Commercial Power generally but with existing condition of power failure, instantaneous power failure and voltage fluctuation
2	UPS	<ul style="list-style-type: none"> ■ The UPS shall be of True online with double conversion topology. ■ The UPS shall work in outdoor environment to ensure all equipment's getting necessary power supply. No power surge. ■ The UPS unit shall have load level indicators that display the approximate electrical load placed upon the UPS. The UPS unit shall have a row of battery level indicators that display the approximate battery capacity. ■ The UPS unit shall have a minimum of the following as per OEM standard indicators: <ul style="list-style-type: none"> ➢ UPS Mode: On-line, Backup/Battery and Bypass; ➢ Over Load Indicator: This will display when UPS is running on overload; ➢ Battery Status Indicator: This will illuminate when battery is low or faulty/disconnected; and ➢ System Fault: This will illuminate when there is some fault or interruption in UPS. ■ The UPS unit shall include Ethernet communication port to support remote management and monitoring capabilities using SNMP including alarm contacts and remote shutdown. Remote monitoring and testing software shall be included. The manufacturer shall provide all SNMP traps. ■ The UPS unit shall include automatic restart. Upon restoration of utility AC power after complete battery discharge, the UPS shall automatically restart and resume operation. ■ The UPS unit shall be compliant to IEC 62040-1, CE, IEC602040-2 safety standards. ■ The UPS and batteries shall be mounted in a separate cabinet & the enclosure shall be under lock & key, utilising the minimum possible space and arranged in an aesthetic manner. ■ Any field UPS system (as per MSI's design) shall be supplied with an environmentally rated cabinet for installation of the UPS and batteries. The cabinet shall have a rating of IP 55. The cabinet shall be supplied with in-built fans and proper ventilation as needed to ensure that the temperature inside the cabinet does not exceed 40 degrees C at any given point in time. ■ Backup time at least 3 hrs or more

5.8 Cabinet

Table 5-7: Hardware Requirement of Cabinet

No.	Item Specification
1.	<ul style="list-style-type: none"> ■ The cabinet shall be electrically and mechanically robust and shall have a degree of protection of IP65 or higher specified in "IEC60529 Degrees of Protection Provided by Enclosures (IP Code)". ■ The cabinet shall have the provision for temperature controlling for optimal performance of equipment. ■ A right hinged door shall be provided on the front to realize easy maintenance work. The turning direction of the handle shall be counterclockwise. ■ The power supply including UPS shall be provided with a circuit breaker. ■ The anti-lightning and surge protection complying with the IEC61643-1 shall be provided.

	<ul style="list-style-type: none"> ■ Protection under/overvoltage condition shall be provided. ■ Monitoring status of temperature, battery and power supply ■ The cabinet shall be finished with the anticorrosive treatment ■ An internal lighting system ■ 220VAC plugs protected by a differential circuit breaker ■ An intercom jack ■ A file holder for the documentation ■ Standard key locks ■ Fixed on metallic cabinet frames (when false floor)
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5.9 Pole

Table 5-8: Hardware Requirement of Pole

No.	Item Specification
1.	<ul style="list-style-type: none"> ■ The Contractor shall conduct the detailed design for the pole based on his site survey. ■ The Contractor shall conduct the appropriate measure for preventing the vibration which will affect the detection accuracy. ■ All components of poles may be hot dip galvanized, all components must be well protected against corrosion, minimum thickness of zinc coatings is 85 μ m and min density 500 gm/m² on both inside and outside surfaces ■ Certified BS EN 10025-4:2019 – TC ■ Required Lighting arrester arrangement inside the pole.

6 Communication Requirement

Table 6-1: Communication Requirements of ATCC

No.	Minimum Specifications
1.	<ul style="list-style-type: none"> ■ Communication between the ATCC server in the CCC and the ATCC roadside equipment shall be Wireless 3G/4G or upcoming 5G Connectivity provided by a single communication company. ■ The required bandwidth to make the system functional shall be proposed by the Contractor

7 Installation Requirement

The Contractor shall make the provision for necessary civil, foundation, earthing, necessary cable conducting, manhole, Power supply, redundant communication, new meter connection, quality, safety and last mile connectivity etc. to meet the functional requirement intended for the system.

The Contractor shall obtain necessary permission from respective agency.

ATCC-1 need to be installed on Chennai Bypass Road and Chennai Outer Ring road and ATCC-2 need to be installed within the city on major link roads .

ATCC camera sensors need to be housed in a cabinet. Sensors should be placed in the median as far as possible. If possible, sensors covering both directions need to be installed in the median on a single pole to optimize installation, civil works, and maintenance cost.

In case sensors are not feasible to be placed in the median, a practical roadside location should be chosen such that detectors can cover all the lanes in the direction under study and optimal detection can be achieved.

Poles, fixtures, and other peripherals should be manufactured in accordance with relevant standards and need to be secured on a foundation.

Chapter 3 Requirements of City Bus System

Chapter 3-1 Requirements of Command Control Centre for City Bus System

1 General

The City Bus System (CBS) shall be an integrated system that supports effective operation of the MTC fleet and accurate real-time information to riders about the status of operations:

The CBS-CCC is intended to achieve the overall objectives as described below.

- (a) The Command Control Centre (CCC) must create an environment in which information is gathered, processed, and disseminated clearly and in real time.
 - (b) Each bus shall be equipped with an On-Board Unit (OBU) for location tracking that incorporates cellular data communications and sends frequent periodic location reports to the central operations management system at the CBS Command Control Centre.
 - (c) These periodic location reports will provide ongoing information about current traffic speed on key road segments, to serve as traffic probes data input to other systems.
 - (d) The Command Control Centre fleet operations management software will support the operation and effective use of a Computer Aided Dispatch / Automatic Vehicle Location (CAD/AVL) system. This will enable tracking of the route and schedule adherence for each vehicle, and the management/logging of incidents.
 - (e) The Passenger Information System (PIS) will use the route and schedule adherence tracking information to provide information about predicted arrival times on PIS at many terminals and bus shelters visible to waiting riders. And providing this real-time information through a website and mobile application.
 - (f) Each depot will be equipped with the Depot Management System (DMS) to enable and manage their effective operation. This software will manage service scheduling, crew rostering, vehicle dispatch, crew attendance, and business intelligence/reporting.
 - (g) Provide information and data management system for the overall control, supervision, configuration, and maintenance of Bus service.
 - (h) Real time monitoring of fleet on GIS map based on geo positions received from the onboard device mounted on buses and simultaneous constant computation of expected arrival times at downstream stations using the efficient travel time algorithms.
 - (i) Operational management and alert monitoring of the buses in real-time to ensure improved efficiency for the agency and better service to the commuters
 - (j) Passive monitoring of safety and security for city service infrastructure and real-time decision making for any emergency management services.
 - (k) Transmitting of all the outputs to the corresponding ITS units at stations or on-board of the buses in real-time through wired / wireless communication system.
 - (l) Transfer necessary information to the concerned agencies like police, GCC and CUMTA authorities.
 - (m) As it supports a lot of data processing and transmitting, CCC requires large amount of communication system to support its operations through wired or wireless.
 - (n) The accurate data analysis includes the data cleaning, fusion and analysis. Once data from the sensors or onboard device received to CCC, it should be checked. Reliable passenger information should be passed on to the public on-time through efficient system having the capabilities to transmit the information through SMS, Internet and to terminal.
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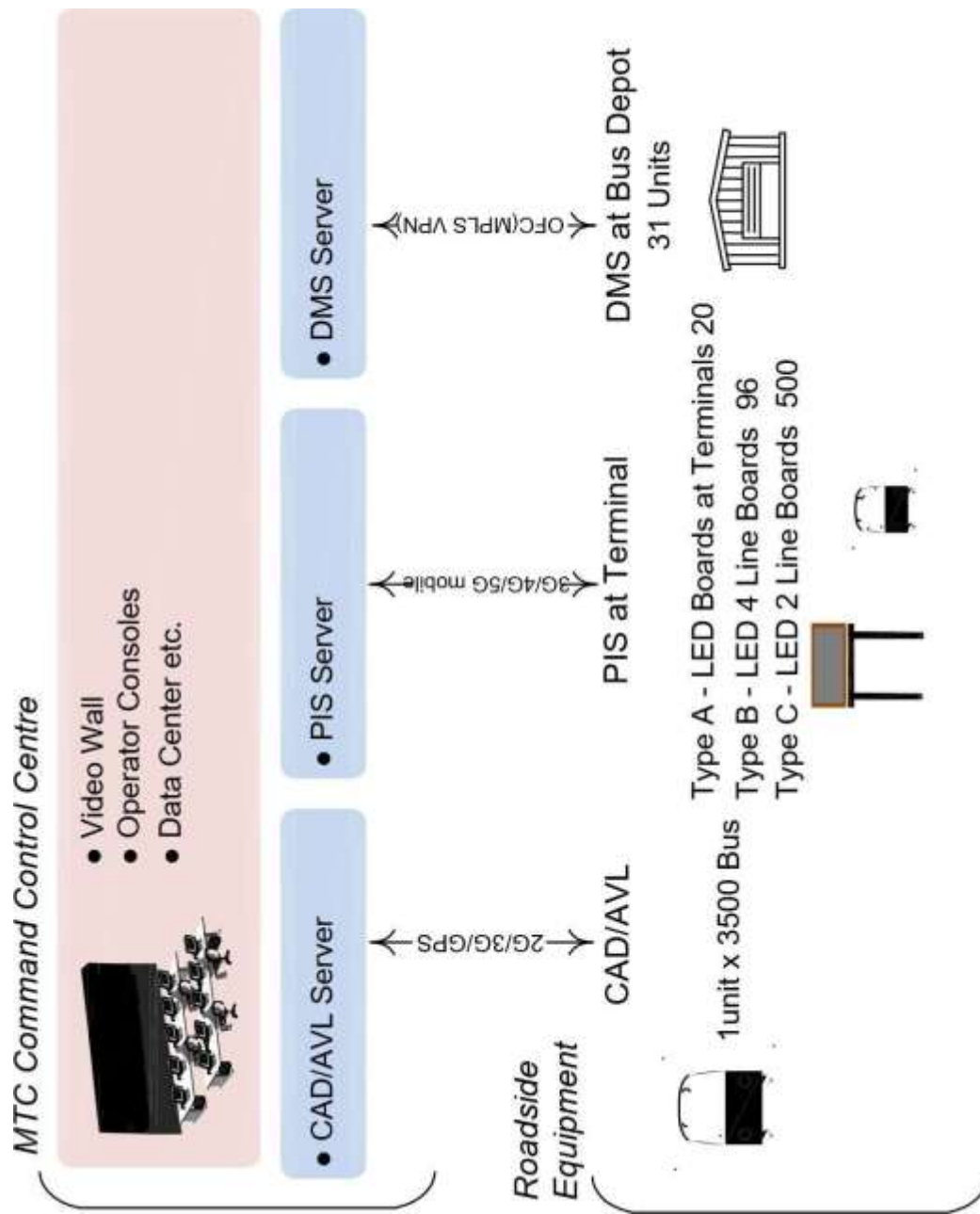


Figure 1-1: Concept of CBS Functions

2 System Configuration

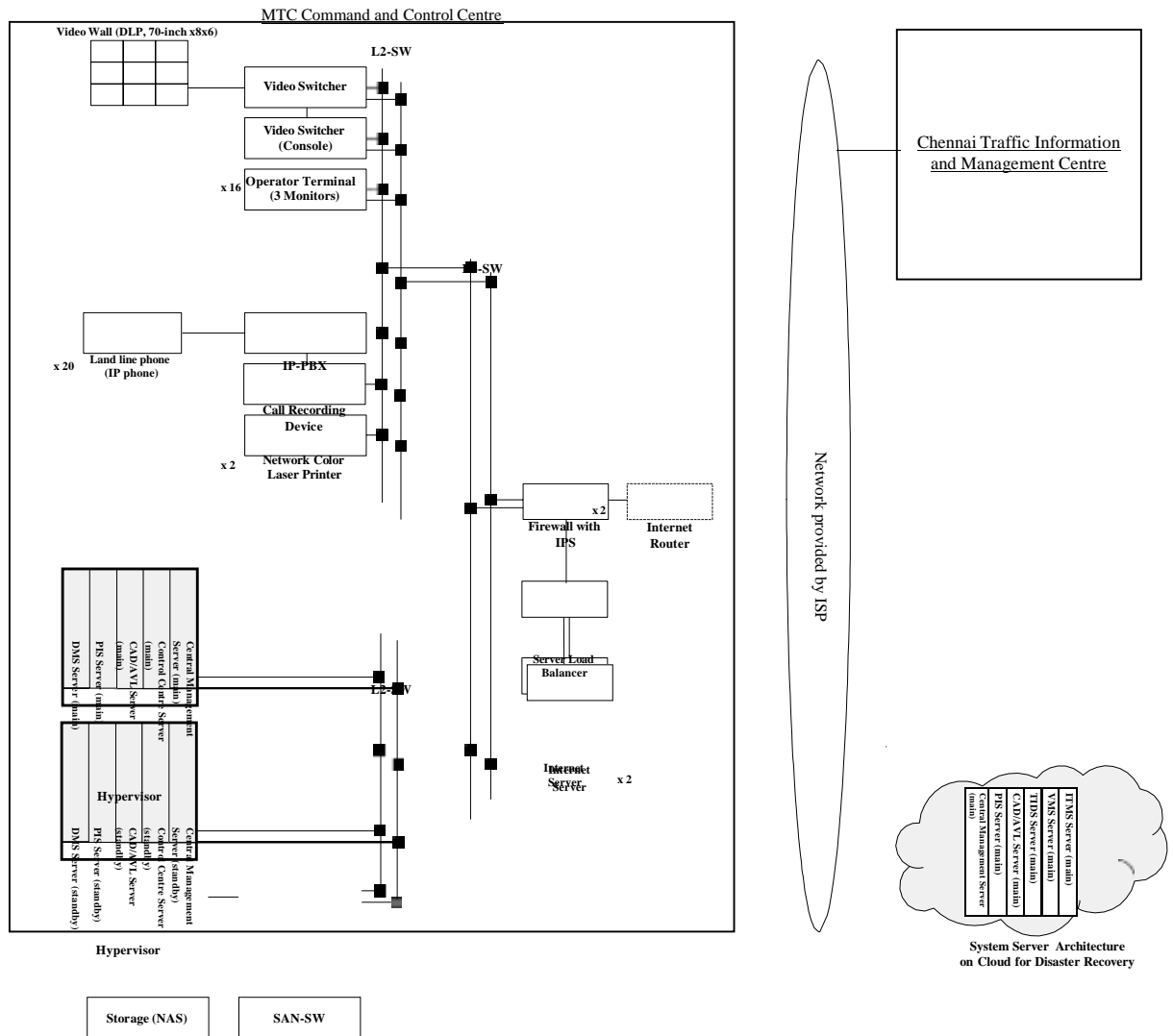


Figure 2-1: System Configuration of CBS Command Control Center

3 Equipment Location

Table 3-1: Location of CBS Command Control Center

No.	Location Type	Location Name
1	CBS Command Control Center	MTC Corporate Office

4 System Functional Requirement

4.1 Server Architecture

The system server architecture for the System is shown in the figure below.

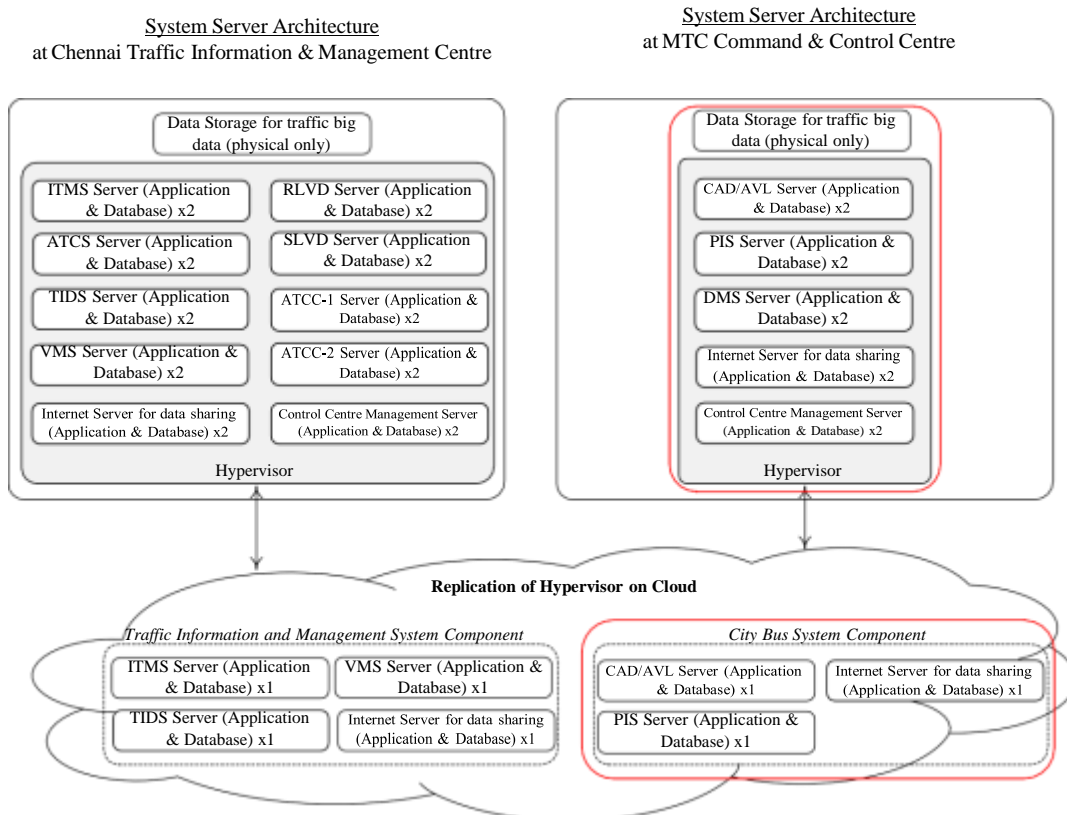


Figure 4-1: System Server Architecture the System

4.2 Data Centre

The data center shall be used to house all active equipment like all Application, Database and Domain server with primary and redundant capability, Security system, Network Switch, IP communication equipment etc. in logical perspective, for CBS application, CAD/AVL, PIS and DMS.

Data center of CBS-CCC shall be the heart and core of MTC to maintain important information and serving communication between field equipment and central system servers. All information held and processed by datacenter is subject to the risks of attack, error and natural disaster, and other vulnerabilities inherent to its use. The up time of the CITS Project systems shall be high and shall maintain security up to high level for data, equipment etc. by the Contractor.

The Contractor shall maintain following standards for Data Center

- TIA – 942: Telecommunications Infrastructure Standard for Data Centre - TIA – 942 defines practical methods to ensure electrical continuity throughout the rack materials and proper grounding of racks and rack – mounted equipment. This is the only specification that addresses problems specific to data center infrastructure.
- ISO 27001 – ISMS: The Data center should comply with ISO 27001 – ISMS guideline provided by International Organization for Standardization. This standard helps organizations keep information assets of the Data center secure.
- Guideline of MUHA and relevant update time to time

4.3 Disaster Recovery

Table 4-1: Functional requirement of Disaster recovery

No.	Requirements
General	
1	<ul style="list-style-type: none"> ■ The Contractor shall propose the suitable disaster recovery plan for the System. ■ The minimum following two (2) servers of City Bus System which will be critical for operation at a time of disaster shall be protected by replicating them on cloud. <p>(1) Computer Aided Dispatch/Automatic Vehicle Location Server (Application and Database) to continue the service to bus users at a time of disaster.</p> <p>(2) Passenger Information Server (Application and Database) to continue the service to bus users at a time of disaster</p>
Replication Method	
2.	<ul style="list-style-type: none"> ■ The Contractor shall propose the suitable replication method for the System. ■ Host based replication will be preferable for the data replication. ■ The traffic big data
Recovery Time Objective (RTO) / Recovery Point Objective (RPO)	
3.	<ul style="list-style-type: none"> ■ Recovery Time Objective (RTO) shall be less than 24.0 hours ■ Recovery Point Objective (RPO) shall be less than 24.0 hours

4.4 Security

Table 4-2: Functional requirement of Security

No.	Requirements
Security requirement	
1.	<ul style="list-style-type: none"> ■ For Control Center End point security is essential to any device that is physically an end point on a network. Laptops, desktops, mobile phones, tablets, servers can all be termed as endpoints. ■ Endpoint security refers to cybersecurity services for network endpoints. These services include antivirus, email filtering, web filtering, and firewall services. Endpoint security plays a crucial role for businesses, ensuring critical systems, intellectual property, customer data, employees, and guests are protected from ransomware, phishing, malware, and other cyberattacks. ■ Endpoint Service Features <ul style="list-style-type: none"> ✓ Anti-virus - Smart Scan leverages anti-malware and antispayware signatures stored in-the-cloud ✓ Anti-spyware - Conventional Scan leverages anti-malware and antispayware components stored locally on Security Agents ✓ Application Control (Win PC only) - Create rules to restrict the applications that can execute or install on the endpoints. ✓ Behavior Monitoring Incl. Ransomware Protection (Win PC only) - Behavior Monitoring protects endpoints from unauthorized changes to the operating system, registry entries, other software, or files and folders. Protect documents against unauthorized encryption or modification, automatically back-up and restore files changed by suspicious programs, Block processes commonly associated with ransomware, enable program inspection to detect and block compromised executable files ■ Endpoint Sensor ■ Firewall (Win PC only) - The firewall can block or allow certain types of network traffic by creating a barrier between the endpoint and the network ■ Full Disk Encryption ■ HTTPS Web Threat Protection

	<ul style="list-style-type: none"> ■ Predictive Machine Learning ■ Role-based Administration ■ Unauthorized Change Prevention Service (Win PCs only) - Regulates application behavior and validates program trustworthiness. ■ URL Filtering - URL Filtering allows administrators to block specific types of websites during different times of the day. ■ Industry leading protection from Virus, Spyware, Phishing and Hacking. URL filtering. USB Port Blocking. Data Theft prevention ■ Web Reputation enhances protection against malicious websites. ■ Physical or virtual network appliance that monitors 360 degrees of network to create complete visibility into all aspects of targeted attacks, advanced threats, and ransomware. ■ Prevent assess potential vulnerabilities and proactively protect endpoints, servers, and applications. Detect advanced malware, behavior, and communications invisible to standard defenses. Enable rapid response through shared threat intelligence and delivery of real-time security updates. Must gain centralized visibility across the network and systems; analyze and assess the impact of threats. ■ Ability to scan through all file types and various compression formats. Ability to scan HTML, VBScript Viruses, malicious applets and ActiveX controls. Able to update itself over internet for virus definitions, program updates etc. (periodically as well as in push-updates in case of outbreaks). ■ Able to perform different scan Actions based on the virus type (Trojan/ Worm, Joke, Hoax, Virus, other). Provides Real-time Product Performance Monitor, Built-in Debug and Diagnostic tools, and context – sensitive help. The solution provides protection to multiple remote clients. Provides for virus notification options for Virus Outbreak Alert and other configurable conditional Notification. Capable of providing multiple layers of defense. Facility to clean, delete and quarantine files affected with virus. Supports online update, whereby most product updates and patches can be performed without bringing messaging server off-line.
CCTV surveillance at Control Centre	
2	<ul style="list-style-type: none"> ■ The Contractor must supply, installation, commissioning, and maintenance of appropriate CCTV system to monitor activity in CBS-CCC related for CITS Project Facilities such as server room, UPS Room, inventory Room etc <ul style="list-style-type: none"> ✓ Fixed Dome Camera ✓ Fixed Bullet Camera ✓ Fisheye Camera ✓ NVR With 42" Monitor ✓ Storage Capacity minimum 4 months ✓ 5 MP or better

4.5 Enterprise Management System

Table 4-3: Functional requirement of Enterprise Management System (EMS)

No.	Requirements
ENTERPRISE MANAGEMENT SYSTEM (EMS)	
Network Management and Control	
1	<ul style="list-style-type: none"> ■ The network management function shall be provided to the system and the function shall continuously monitor the Level 2 switch and Layer 3 switch using Simple Network Management Protocol (SNMP). In case of identification of a malfunction, the network management system shall issue an alarm to the operator console and at the same time store the malfunction record in the network operation log.

No.	Requirements
	<ul style="list-style-type: none"> ■ Database storage shall have a capacity of 2 years for recording the operation log. ■ SLA calculation and reporting function shall be provided. ■ The proposed system shall support multiple types of discovery like IP range discovery – including built-in support for IPv6, Seed router-based discovery, and discovery whenever new devices are added with the capability to exclude specific devices. ■ The proposed system shall support the exclusion of specific IP addresses or IP address ranges. ■ The proposed solution shall provide a detailed asset report, organized by proper naming of all devices, listing all ports for all devices. The proposed system shall provide sufficient reports that identify unused ports in the managed network infrastructure that can be reclaimed and reallocated. ■ The proposed solution shall determine device availability and shall exclude outages from the availability calculation with an option to indicate the reason. ■ The proposed solution shall provide the box root cause analysis. ■ The proposed solution shall have an integrated user-friendly application. ■ The proposed solution shall include all required licenses. ■ The proposed solution shall provide real-time monitoring of the entire network infrastructure and shall allow users to easily navigate with a graphical interface and easy-to-use network management tools. ■ The proposed solution shall provide at a minimum, event alert via the existing Microsoft Exchange Server email or pop-up alarm or export to CSV. ■ The proposed solution shall automatically generate reports on a daily, weekly, and monthly basis in formats including graphs, bar charts, distribution, and summary. The system shall be capable of printing out reports and also exporting the reports to other systems or web servers. ■ The proposed solution shall display a simple map of the whole network as a tree and shall have the option of direct selection of objects. The system shall provide a navigation tree to display the current alarm status of each subnet. All the systems shall support PAN/ ZOOM feature and shall have all the devices visible in one window along with the provision for these two features ■ The proposed solution shall provide polling agents to upload status, changes, or alerts of the local devices attached with the Ethernet enabling devices. ■ The proposed solution shall provide real-time Management Information Bases (MIBs) displays and shall provide the MIB variable data in tabular or graphical format. The MIB displays shall provide various expressions like utilization, percentage errors, and volume ■ The proposed solution shall provide features for security and accountability and shall generate a log file for any user access to configuration or platform changes. ■ The proposed solution shall be capable of managing any SNMP/ICMP device from any vendor. ■ The proposed solution shall support SNMPV1, SNMPV2C, and SNMPV3 and shall automatically discover and poll SNMP and ICMP devices. ■ SNMP traps for all IP-enabled devices shall be provided by the respective product manufacturers. ■ The proposed solution shall allow notifications to be automatically sent to phones, offsite workstations, etc. for efficient response. ■ The proposed solution shall monitor as a minimum the base station unit and the subscriber station units along with other IP-enabled equipment that is being provided as part of this Project. ■ The proposed solution shall allow for providing different levels of security access i.e., viewing, logging and managing.

No.	Requirements
	<ul style="list-style-type: none"> ■ The proposed solution shall allow for the display of different colors for the links including red, green, orange, yellow to show the status of the links and the connected devices ■ The operation of the NMS shall be tested while the backbone network is under 30% network utilization. ■ The proposed solution must provide an interface for IT helpdesk personnel to create guest credentials. ■ The proposed solution shall be supplied with a server with Windows or Linux-based OS (latest) or later.
Service Level - Monitoring, Management, and Reporting	
2	<ul style="list-style-type: none"> ■ The proposed service management system shall provide a detailed service dashboard view indicating the health of each of the components and services provisioned as well as the SLAs ■ The system shall provide an outage summary that gives a high-level health indication for each service as well as the details and root cause of an outage. ■ The system shall be capable of managing IT and Non-IT resources in terms of the business services they support, specify and monitor service obligations, and associate users/Departments/ Organizations with the services they rely on and related Service/Operational Levels Agreements. Presently, services shall include E-mail, Internet Access, Intranet, and other services hosted. ■ SLA violation alarms shall be generated to notify whenever an agreement is violated or is in danger of being violated. These alarms shall be automatically shared with the authorized people. ■ The system shall provide the capability to designate planned maintenance periods for services and take into consideration maintenance periods defined at the IT resources level. In addition, the capability to exempt any service outage from impacting an SLA shall be available. ■ The reports supported shall include one that monitors service availability (including Mean Time to Repair (MTTR), Mean Time Between Failure (MTBF), and Maximum Outage Time thresholds) and the other that monitors service transaction response time. ■ The system shall provide a historical reporting facility that shall allow for the generation of on-demand and scheduled reports of Service-related metrics with capabilities for customization of the report presentation.
Application Performance - Monitoring, Management, and Reporting	
3	<ul style="list-style-type: none"> ■ The proposed solution shall proactively monitor all user transactions for any web application hosted; detect failed transactions; gather evidence necessary for triage and diagnosis of problems that affect user experiences and prevent completion of critical business processes. ■ The proposed solution shall determine if the cause of performance issues is inside the application, in connected back-end systems, or at the network layer. ■ The proposed solution shall correlate performance data from HTTP Servers (external requests) with internal application performance data. ■ The proposed solution shall see response times based on different call parameters. For example, the proposed solution shall be able to provide CPU utilization metrics. ■ The proposed solution shall allow data to be seen only by those with a need to know and limit access by user roles. ■ The solution shall be deployable as an appliance or physical or virtual server-based system acting as an active/passive listener on the network thus inducing zero overhead on the network and application layer.

No.	Requirements
	<ul style="list-style-type: none"> ■ The proposed solution shall be able to provide the ability to detect and alert which exact end-users experience HTTP error codes such as 404 errors or errors coming from the web application. ■ The proposed system shall be able to detect user-impacting defects and anomalies and reports them in real-time for Slow Response Time, Fast Response time, Low Throughput, Partial Response, Missing component within the transaction. ■ The proposed system shall be able to instantly identify whether performance problems like slow response times are within or outside the Datacenter without having to rely on network monitoring tools.
Systems and Database Performance - Monitoring, Management, and Reporting	
4	<ul style="list-style-type: none"> ■ The proposed system shall address management challenges by providing centralized management across physical and virtual systems. ■ The proposed system shall be able to monitor various operating system parameters such as processors, memory, files, processes, file systems, etc. where applicable, using operators on the servers to be monitored. ■ It shall be possible to configure the operating system monitoring operators to monitor based on user-defined thresholds for warning/critical states and escalate events to the event console of the enterprise management system. ■ It shall also be able to monitor various operating system parameters depending on the operating system being monitored yet offer a similar interface for viewing the operators and setting thresholds. ■ The proposed solution shall support monitoring Processors, File Systems, Log Files, System Processes, and Memory, etc. ■ The proposed tool shall provide Process and NT Service Monitoring wherein if critical application processes or services fail, administrators are immediately alerted, and processes and services are automatically restarted. ■ The proposed tool shall be able to provide Log File Monitoring which enables the administrator to watch system logs and text log files by specifying messages to watch for. When matching messages get logged, the proposed tool shall notify administrators and enable them to take action like sending an email. ■ The proposed database performance management system shall integrate network, server & database performance management systems and provide a unified view of the performance state in a single console. ■ It shall be able to automate monitoring, data collection, and analysis of performance from a single point. ■ It shall also provide the ability to set thresholds and send notifications when an event occurs, enabling Database Administrators (DBAs) to quickly trace and resolve performance-related bottlenecks. ■ Role-based Access — Enables role-based management by defining access privileges according to the role of the user. ■ The proposed Virtual Performance Management system shall integrate the latest virtualization technologies.
Helpdesk - Monitoring, Management, and Reporting	
5	<ul style="list-style-type: none"> ■ The proposed helpdesk system shall provide flexibility of logging, viewing, updating, and closing incident manually via the web interface. ■ The proposed helpdesk system shall support ITIL processes like request management, problem management, configuration management, and change order management with out-of-the-box templates for various ITIL service support processes. ■ Each incident shall be able to associate multiple activity logs entries via a manual update

No.	Requirements
	<p>or automatic update from other enterprise management tools.</p> <ul style="list-style-type: none"> ■ The proposed helpdesk system shall be able to provide flexibility of incident assignment based on the workload, category, location, etc. ■ Each escalation policy shall allow easy definition on multiple escalation levels and notification to different personnel via window GUI/console with no or minimal programming. ■ The proposed helpdesk system shall provide grouping access to different security knowledge articles for different groups of users. ■ The proposed helpdesk system shall have an updatable knowledge base for technical analysis and further help end-users to search for solutions for previously solved issues. ■ The proposed helpdesk system shall support tracking of SLA (Service Level Agreements) for call requests within the help desk through service types. ■ The proposed helpdesk system shall be capable of assigning call requests to tech al staff manually as well as automatically based on predefined rules, and shall support notification and escalation over email, web, etc. ■ The proposed helpdesk system shall integrate tightly with the knowledge tools and CMDB and shall be accessible from the same login window. ■ It shall allow the IT team to create solutions & make them available on the end-user login window for the most common requests. ■ The helpdesk shall be a web-enabled management system with an SMS and email-based alert system for the Helpdesk Call management and SLA reporting. ■ The Help desk shall log user calls related to the system and assign an incident/ call ID number. Severity shall be assigned to each call as per the SLAs. ■ Helpdesk shall track each incident/call to resolution. Escalate the calls, to the appropriate levels, if necessary, as per the escalation matrix agreed upon with Authority/authorized entity.
Traffic Analysis through EMS	
6	<ul style="list-style-type: none"> ■ The traffic analysis system shall be from the same OEM providing Network Fault & Performance Management System. ■ The tool shall support Flow monitoring and traffic analysis for NetFlow, J-Flow, sFlow, Netstream, IPFIX technologies. ■ The solution shall provide a central web-based integration point across any of the flow protocols and shall be able to report from a single console. ■ The solution shall be of passive-type and should not cause any performance overheads.
Incident Management and Root Cause Analysis Reporting	
7	<ul style="list-style-type: none"> ■ An information security incident is an event (or chain of events) that compromises the confidentiality, integrity, or availability of information. All information security incidents that affect the information or systems of the enterprise (including malicious attacks, abuse/misuse of systems by staff, loss of power/communications services, and errors by users or computer staff) shall be dealt with following a documented information security incident management policy ■ Incidents shall be categorized and prioritized. While prioritizing incidents the impact and urgency of the incident shall be taken into consideration. ■ It shall be ensured that the incident database is integrated with the Known Error Database (KeDB), Configuration Management Database (CMDB). These details shall be accessible to relevant personnel as and when needed. ■ Testing shall be performed to ensure that recovery action is complete and that the service has been fully restored.

No.	Requirements
	<ul style="list-style-type: none"> ■ When the incident has been resolved, it shall be ensured that the service desk records of the resolution steps are updated and confirm that the action taken has been agreed to by the end-user. Also, unresolved incidents (known errors and workarounds) shall be recorded and reported to provide information for effective problem management. ■ Information security incidents and weaknesses associated with information systems shall be communicated in a manner allowing timely corrective action to be taken
Change and Configuration Management	
8	<ul style="list-style-type: none"> ■ Change management provides information on changes and enables better control of changes to reduce errors and disruption in services. ■ All changes shall be initiated using a change management process, and a Request for Change (RFC) shall be created. All change requests shall be evaluated to determine the impact on business processes and IT services and to assess whether change shall adversely affect the operational environment and introduce unacceptable risk. ■ All changes are logged, prioritized, categorized, assessed, authorized, planned, and scheduled to track and report all changes. All the logs should be immutable. ■ Ensure review of changes for effectiveness and take actions agreed with interested parties. Change requests shall be analyzed at planned intervals to detect trends. The results and conclusions drawn from the analysis shall be recorded and reviewed to identify opportunities for improvement. ■ The roles and responsibilities of the management shall include review and approval of the implementation of change management policies, processes, and procedures ■ A configuration management database shall be established which stores unique information about each type of Configuration Item CI or group of CI. ■ The Configuration Management Database (CMDB) shall be managed such that it ensures its reliability and accuracy including control of update access. ■ The degree of control shall maintain the integrity of services and service components taking into consideration the service requirements and the risks associated with the CI. ■ Corrective actions shall be taken for any deficiencies identified in the audit and shall be reported to the management and process owners ■ Information from the CMDB shall be provided to the change management process and the changes to the CI shall be traceable and auditable. ■ A configuration baseline of the attached CI shall be taken before deployment of a release into the live environment. It shall be stored in a safe environment with appropriate access control. ■ Master copies of CI shall be recorded in the CMDB and shall be stored in secure physical or electronic libraries which shall be referenced in the configuration records. This shall apply to documentations, license information, software, and hardware configuration images. ■ The NMS shall facilitate the retrieval, storage, analysis, and display of status information from all network devices attached to the system that are SNMP and/or ICMP capable and shall facilitate remote configuration of these devices. NMS shall support both IPv4 and IPv6 device integration. ■ The NMS shall provide the ability to view the network and its associated IP SNMP/ICMP enabled devices including switches and other IP devices connected over the network. It shall support a minimum of 10,000 endpoints

5 Hardware Requirement

All hardware equipment shall as a minimum, meet all the requirements listed in the specifications. The equipment's provided shall accommodate to future technological advances which exceeds the minimum requirements provided in the specifications.

5.1 Servers

Table 5-1: Hardware requirement of Servers

No.	Items	Requirements
1	General	<ul style="list-style-type: none"> ■ Minimum 6U size, rack-mountable, capable of accommodating minimum 8 or higher hot-pluggable blades ■ Have the capability for installing industry-standard flavors of Microsoft Windows, and Enterprise RedHat Linux OS as well as virtualization solutions such as VMware. ■ DVD ROM shall be available in chassis, can be internal or external, which can be shared by all the blades allowing remote installation of software ■ Minimum 1 USB port
2	Processor	<ul style="list-style-type: none"> ■ Latest series/ generation of 64-bit x86 processor(s) with Ten or higher Cores ■ Processor speed should be a minimum of 2.4 GHz ■ Minimum 2 processors per physical server
3	RAM	Min. 24 DIMM slots, should be provided with 256 GB RAM using DDR4 DIMM's operating at 2666 MT/s (depending on processor model)
4	Internal Storage	2 x 400 GB SAS (10k rpm) hot swap disk with extensible bays
5	Network interface	2 X 20GbE LAN ports for providing Ethernet connectivity Optional: 1 X Dual-port 16Gbps FC HBA for providing FC connectivity
6	Power supply	Dual Redundant Power Supply
7	RAID support	As per requirement/solution
8	Operating System	The licensed version of 64 bit latest version of Linux/ Unix/Microsoft® Windows-based Operating system
9	Form Factor	Rack mountable/ Blade
10	Virtualization	Shall support Industry-standard virtualization hypervisors like Hyper-V, VMWARE, and Citrix.
11	Storage controller	SAS Raid Controller with RAID 0/1
12	Bus Slots	Minimum of 2 Nos of PCIe 3.0 based mezzanine slots supporting Converged Ethernet adapters
13	Motherboard	Intel Chipset compatible with the offered processor
14	Interfaces	Minimum of 1 Internal USB 3.0 port, 1 Internal SD Card Slot
15	Redundancy	Must have port level and card level redundancy

No.	Items	Requirements
16	Operating System & Virtualization Support	<ul style="list-style-type: none"> ■ Microsoft Windows Server (latest version) ■ Red Hat Enterprise Linux (RHEL) (latest version) ■ SUSE Linux Enterprise Server (latest version) ■ VMware / feature-rich virtualization software supporting solution design & stack
17	Warranty	5 Year OEM Warranty

5.2 Video Wall

Table 5-2: Hardware requirement of Video wall

No.	Item	Requirements
1.	Display Type	Color DLP Laser or LED light source
2.	Display Size	70 inches or higher - DLP Cube- With Laser Light Source or LED Light Source – SLIM Cube
3	Videowall Grid	Videowall in the matrix with 9 (3 cubes in column and 3 cubes in row)
4.	Number of pixels	1920×1080 (full HD), 16:9 Widescreen
5.	Contrast Ratio	1800:1 or higher
6.	Brightness	700 nits
7.	Bezel-to-Bezel Width	0.44 or Bezel less
8.	Viewing angle	178 degree/178 degree (H/V)
9.	Access to the Cube	Front/Rear access
10.	Input Signal	RGB Digital, DVI-D or HDMI (Input interface shall be compatible with output interface of Video Switches.)
11.	Control input	RS-232C(D-SUB9) or RJ-45(10/100BASE-T)
12.	Expected Power Consumption	400VA or less
13.	Mount	VESA Standard Mount Interface
14.	Control	On Screen Display (OSD) - IP/IR remote control
15.	Operations	24 x 7, Life of light source 100000 hrs in eco-mode.
16.	Standards	BIS or equivalent

5.3 Video Wall Controller

Table 5-3: Hardware requirement of Video wall controller

No	Item	Requirements
1.	Controller	Controller to control Video wall as per requirement along with software

2.	Chassis	19" Rack mount
3.	Processor	Latest Generation 64-bit Quad Core processor (3.3Ghz) or better
4.	Operating System	Pre-loaded 64-bit Operating System Windows / Linux / Equivalent, with recovery disc
5.	RAM	16 GB DDR3 ECC RAM
6.	HDD	2x500 GB 7200 RPM HDD
7.	Networking	Ethernet Controller with RJ-45 port
8.	Power Supply	(1+1) Redundant hot swappable
9.	Accessories	Keyboard and Optical USB mouse
10.	USB Ports	Minimum 4 USB Ports
11.	Redundancy support	Power Supply, HDD, LAN port & Controller
12.	Scalability	Display multiple source windows in any size, anywhere on the wall
13.	Control functions	Brightness/Contrast/ Saturation/ Hue/ Filtering/ Crop/ Rotate
14.	Inputs	Controller should also have at least
		12 or 24 DVI/HDMI inputs for connecting workstations
15.	Output	To connect to required Displays through HDMI/DVI
16.	Operating Temperature	10°C to 35°C, 80 % humidity
17.	Cable & Connections	The Contractor should provide all the necessary cables and connectors, so as to connect Controller with Display units
18.	Integration	Seamless integration among display unit, controller, wall management software to be ensured. Preferred to have same OEM.

5.4 Video Wall Management Software

Table 5-4: Requirement of Video wamm Management Software

No	Items	Requirements
1.	Display & Scaling	At least 20 layers
2.	Input Management	All input sources can be displayed on the video wall in freely resizable and movable windows
3.	Scenarios management	Save and load desktop layouts from local or remote machines
4.	Layout Management	Support all layout from input sources, Internet Explorer, desktop and remote desktop application
5.	Multi View Option	Multiple view of portions or regions of Desktop, multiple application can view from single desktop
6.	Other features	SMTP support
7.		Remote Control over LAN
8.		Alarm management
9.		Remote management
10.		Multiple concurrent client

11.		KVM support
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5.5 LED Display

Table 5-5: Hardware requirement of LED display

No	Item	Requirements
1.	Product Type	LED-backlit LCD flat panel display with touchscreen
2.	Diagonal Size	70"
3.	Commercial Use	Yes - interactive
4.	Resolution	1920 x 1080
5.	Display Format	1080p (Full HD)
6.	Video Interface	HDMI
7.	HDMI Ports Qty	3 ports
8.	PC Interface	VGA (HD-15), DisplayPort, Mobile High-Definition Link (MHL)
9.	LCD Backlight Technology	LED backlight
10.	Image Aspect Ratio	16:9
11.	TV Tuner	No tuner
12.	Speaker System	2 speakers
13.	USB	Yes
14.	Included Accessories	Remote control, 2 styluses, stylus pen holder, wireless remote control, wire saddle, remote control holder, LSA1U wall mount kit
15.	Voltage	AC 120/230 V (50/60 Hz)
16.	Power Consumption Operational	220 Watt
17.	Power Consumption Stand by	0.4 Watt
18.	Dimensions (WxDxH)	159.35 cm x 9.51 cm x 93.261 cm
19.	Environmental Standards	ENERGY STAR Qualified

5.6 Data Storage

Table 5-6: Hardware Requirement of Data Storage

No	Item	Requirements
1.	Solution/ Type	IP Based/iSCSI/FC/NFS/CIFS
2.	Storage	Storage Capacity should be a minimum of 50 TB (usable, after configuring in offered RAID configuration) for online and Near-line data.
		RAID solution offered must protect against double-disc failure.
		Disks should be preferably minimum of 8 TB capacity
		To store all types of data (Data, Voice, Images, Video, etc)
		Storage system capable of scaling vertically and horizontally
3.	Hardware Platform	Rack-mounted form-factor
		Modular design to support controllers and disk drives expansion
4.	Controllers	At least 2 Controllers in active/active mode
		The controllers / Storage nodes should be upgradable seamlessly, without any disruptions/downtime to production workflow for performance, capacity enhancement, and software/firmware upgrades.
5.	RAID support	RAID 0, 1, 1+0, 5+0 and 6

No	Item	Requirements
6.	Cache	Minimum 128 GB of useable cache across all controllers. If the cache is provided in additional hardware for a unified storage solution, then the cache must be over and above 128 GB.
7.	Redundancy and High Availability	The Storage System should be able to protect the data against a single point of failure concerning hard disks, connectivity interfaces, fans, and power supplies
8.	Management software	<p>All the necessary software (GUI Based) to configure and manage the storage space, RAID configuration, logical drives allocation, snapshots, etc. are to be provided for the entire system proposed.</p> <p>Licenses for the storage management software should include disc capacity/count of the complete solution and any additional disks to be plugged in in the future, up to the max capacity of the existing controller/units.</p> <p>A single command console for the entire storage system.</p> <p>Should also include storage performance monitoring and management software</p> <p>Should provide the functionality of proactive monitoring of Disk drive and Storage system for all possible disk failures</p> <p>Should be able to take "snapshots" of the stored data to another logical drive for backup purposes</p>
9.	Data Protection	The storage array must have a complete cache protection mechanism either by de-staging data to disk or providing complete cache data protection with battery backup for up to 4 hours

5.7 Backup Software

Table 5-7: Hardware requirement of Backup software

No	Item	Requirements
1	General	<ul style="list-style-type: none"> ■ The software shall be able to back up the necessary and relevant video feeds from storage, various databases, etc. The device should provide minimum throughput of 10Gbps ■ Should support file-level backup/recovery. ■ Should perform Scheduled unattended backup using policy-based management for all Server and OS platforms ■ The software should support online backup and restore of various applications and Databases ■ Should support database platforms like Microsoft Exchange Server, Oracle, Microsoft SQL Server, Microsoft SharePoint, Sybase, MySQL, Informix, IBM Domino (Lotus), SAP, IBM DB2, Big database etc. ■ Should support backup hardware like tape, virtual tape, optical, disk, interface hardware, etc ■ The backup software should be capable of having multiple back-ups sessions simultaneously ■ The backup software should support different types of backup such as Full back up, Incremental back up, Differential back up, Selective back up, Point in Time back up, and Progressive Incremental back up and snapshots

		<ul style="list-style-type: none"> ■ The backup software should support different types of user interface such as GUI, Web-based interface Should have logging and reporting features
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5.8 Tape Library

Table 5-8: Hardware requirement of Tape library

No.	Requirements
1.	<ul style="list-style-type: none"> ■ Shall support Native data capacity of 200TB ■ (uncompressed) expandable to 400TB (compressed).
2	<ul style="list-style-type: none"> ■ Shall be offered with Minimum of four LTO7 FC tape drive. Drive shall support encryption.
3	<ul style="list-style-type: none"> ■ Shall be offered with minimum of 48 Cartridge slots and scalable to minimum 100 Cartridge
4	<ul style="list-style-type: none"> ■ Tape Library shall provide 8 Gbps native FC connectivity to SAN switches.
5	<ul style="list-style-type: none"> ■ Library shall be able to back up the encrypted keys in a redundant fashion
6	<ul style="list-style-type: none"> ■ Tape Library shall provide web based remote management.
7	<ul style="list-style-type: none"> ■ The library should have cartridge I/O slots for secure & easy off-site backup storage
8	<ul style="list-style-type: none"> ■ Tape Library shall have GUI Panel ■ Shall be rack mountable. ■ Shall have option for redundant power supply
9	<ul style="list-style-type: none"> ■ Should support industry leading backup software
10	<ul style="list-style-type: none"> ■ 40 LTO7 barcode labelled cartridges & 4 cleaning cartridges from the tape library OEM to be provided

5.9 Network Switch -Level 2

Table 5-9: Hardware Requirement of Network Switch -Level 2

No.	Item	Requirements
1.	Switching bus	56 Gbps or more Switching fabric capacity or better
2.	WAN Interface	1) 10/100BASE-TX x4 port or more 2) Optical port (Media Converter) x2 port or more
3.	LAN Interface	100/1000BASE-T x16 port or more and two SFP
4.	LAN Protocol	TCP/IP, IP Multicast
5.	Level 2 switching function	Present
6.	Maximum VLAN	200 or better
7.	VLAN Trunk function	<ul style="list-style-type: none"> • Support 802.1Q Tagged VLAN and port-based VLANs and Private VLAN • The switch must support dynamic VLAN Registration or equivalent • Dynamic Trunking protocol or equivalent • Should support Media access control (MAC) authentication to provide simple authentication based on a user's MAC address
8.	Spanning Tree	Possible
9.	Routing Protocol	<ul style="list-style-type: none"> • RIP, RIPv2, OSPF

		<ul style="list-style-type: none"> • Network Time Protocol or equivalent Simple Network Time Protocol support. • The switch should support traffic segmentation. • Traffic classification should be based on user-definable application types: TOS, DSCP, Port-based, TCP/UDP port number
10.	Multicast	IGMP
11.	Monitoring/control	SNMPv1, v2, and v3 and Remote monitoring (RMON) support
12.	Power	AC230V
14	Grade	Industrial

5.10 Network Switch -Level 3

Table 5-10: Hardware Requirement of Network Switch -Level 3

No.	Item	Requirements
1.	Switching bus	56 Gbps or more Switching fabric capacity or better
2.	WAN Interface	1) 10/100BASE-TX x4 port or more 2) Optical port (Media Converter) x2 port or more
3.	LAN Interface	100/1000BASE-T x16 port or more and two SFP
4.	LAN Protocol	TCP/IP, IP Multicast
5.	Layer 3 switching function	Present
6.	Maximum VLAN	200 or better
7.	VLAN Trunk function	Support 802.1Q Tagged VLAN and port based VLANs and Private VLAN The switch must support dynamic VLAN Registration or equivalent Dynamic Trunking protocol or equivalent
8.	Spanning Tree	Possible
9.	Routing Protocol	RIP, RIPv2, OSPF Network Time Protocol or equivalent Simple Network Time Protocol support. Switch should support traffic segmentation. Traffic classification should be based on user-definable application types: TOS, DSCP, Port based, TCP/UDP port number
10.	Multicast	IGMP
11.	Monitoring/control	SNMP
12.	Power	AC230V

5.11 SAN Switch

Table 5-11: Hardware requirement of SAN switch

No.	Item	Requirements
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1.	Converge	Fiber switch should be quoted with a minimum of 48 FC ports of 16 Gbps speed with all supported licenses from day one.
2.	Protocols	Fibre channel or Ethernet
3.	Controllers	The switch should have auto-sensing, zoning, integrate Ethernet, and a serial port for communication
4.	Chassis	The switch should be rack-mountable 1U size and should be supplied with a mounting kit
5.	Redundancy	The switch should be equipped with a redundant hot-swap power supply and fan and allow hot-swap ability with resetting the switch or affecting the operations of the switch

5.12 Load Balancer

Table 5-12: Hardware requirement of Load balancer

No	Item	Requirements
1	General	<ul style="list-style-type: none"> ■ The device should support load balancing of both TCP and UDP based traffic using algorithms like round-robin, weighted round-robin, least connections, persistent connects, etc ■ The device should provide minimum throughput of 10Gbps ■ The device should provide 4x10G ports scalable to an additional 4x10G ports ■ Should support Client availability (Heartbeat) monitoring ■ Should support High Availability in Active-Active, Active-Passive mode. ■ Should be Manageable using CLI(SSH), WebUI(SSL), SNMP (V1, V2, V3), etc. ■ The management option should allow configuration, operation, firmware upgrade, traffic reporting, error logs, status logs ■ Should support IPv6 from day one ■ Should support static and dynamic routing ■ Should support Global Server Load balancing, URL based Load balancing, HTTP, HTTP redirection, HTTP Layer 7 redirection, DNS redirection, DNS Fallback redirection, ■ Should be able to create and load HTTP/SSL certificates ■ Should be Rack-mountable & should be supplied with Indian standard AC power cord ■ Should support multiple instances having dedicated CPU, memory, SSL & I/O for guaranteed performance

5.13 Firewall

Table 5-13: Hardware Requirement of Firewall

No	Item	Requirements
1	Physical attributes	<ul style="list-style-type: none"> ■ Should be mountable on 19" Rack ■ Modular Chassis ■ Internal redundant power supply
2	Interfaces	<ul style="list-style-type: none"> ■ Minimum 8 x 10 GBPS Interface ■ Console Port 1 number
3	Performance and Availability	<ul style="list-style-type: none"> ■ Encrypted Next Generation Firewall Throughput: minimum 20 Gbps for internet and 20 Gbps for intranet firewall" ■ Concurrent connections: up to 100,000 ■ Simultaneous VPN tunnels: 2000
4	Routing Protocols	<ul style="list-style-type: none"> ■ Static Routes ■ RIPv1, RIPv2 ■ OSPF
5	Protocols	<ul style="list-style-type: none"> ■ TCP/IP, PPTP ■ RTP, LEVEL 2TP ■ IPSec, GRE, DES/3DES/AES ■ PPPoE, EAP-TLS, RTP ■ FTP, HTTP, HTTPS ■ SNMP, SMTP ■ DHCP, DNS ■ Support for Ipv6
6	Other support	<ul style="list-style-type: none"> ■ 802.1Q, NAT, PAT, IP Multicast support, Remote Access VPN, Time based Access control lists, URL Filtering, support VLAN, Radius/ TACACS
7	QoS	<ul style="list-style-type: none"> ■ QoS features like traffic prioritization, differentiated services, committed access rate. Should support for QoS features for defining the QoS policies.
8	Management	<ul style="list-style-type: none"> ■ Console, Telnet, SSHv2, Browser based configuration ■ SNMPv1, SNMPv2 ■ Should Support SDK for IOT

5.14 Network Rack/ Server Rack

Table 5-14: Hardware Requirement of Network Rack/Server Rack

No.	Item	Requirements
1.	Structure	In house independent type (Floor Mounted 19" 42U Rack)
2.	Material	<ul style="list-style-type: none"> ■ Steel plate or Aluminium extruded profile ■ 42U with Heavy Duty Extruded Aluminium Frame for rigidity. Top cover with FHU provision. Top & Bottom cover with cable entry gland plates. Heavy Duty Top and Bottom frame of MS. Two pairs of 19" mounting angles with 'U' marking. Depth support channels - 3 pairs with an overall weight carrying Capacity of 500Kgs. ■ Detachable side panels (set of 2 per Rack) ■ All racks should have mounting hardware 2 Packs, Blanking Panel. ■ Stationery Shelf (2 sets per Rack).

		<ul style="list-style-type: none"> ■ All racks must be lockable on all sides with unique key for each rack. ■ Racks should have Rear Cable Management channels, Roof and base cable access. ■ The racks must have steel (solid / grill / mesh) front / rear doors and side panels. Racks should NOT have glass doors / panels. Front and Back doors should be perforated with at least 63% or higher perforations. Both the front and rear doors should be designed with quick release hinges allowing for quick and easy detachment without the use of tools.
4.	Plate thickness	t=1.5mm more
5.	Cable manager	Four nos. of Horizontal covered PVC Cable manager and two nos. of Verticals covered PVD cable manager.
6.	Power Distribution Units	Two nos. of Vertically Mounted PDU 12 Point (5/15 amp) and 12 power outs IEC C13 sockets, 32 AMPS MCB, Surge and Spike Protection, LED Readout,
7.	Earthing Kit	Should have Rack Ground Kit of 5 KV AC isolated input to Ground & Output to Ground
8.	Ventilation	The rack shall have proper exhaust / ventilation using at least 4 fans housing units on top of the rack

5.15 UPS Parallel Redundant

Table 5-15: Hardware Requirement of UPS

No.	Item	Requirements
1.	Input voltage	<ul style="list-style-type: none"> ■ Commercial Power generally but with existing condition of power failure, instantaneous power failure and voltage fluctuation
2	UPS	<ul style="list-style-type: none"> ■ Adequate capacity to cover the System Components at respective location ■ Three 3 hours or longer backup power supply for Equipment in TIMS-CCC. ■ Ability to shutdown equipment safely when low battery. ■ Ability to start up equipment safely when restoration of AC power. ■ Protection for voltage fluctuation and voltage spike. ■ Output: AC 230 V / 50 Hz sine wave, constant voltage and constant frequency. ■ Long life battery to meet the Design Life. ■ Output condition shall meet equipment to be supplied by the Contractor. ■ Applying appropriate measures in order to be available even in severe environmental conditions outdoors.

5.16 Wi-Fi Equipment

Table 5-16: Hardware requirement of Wi-Fi equipmen

No.	Item	Requirements
1.	Wi-Fi	<p>Contractor shall implement industrial grade and rugged Wi-Fi router device in CCC to support and operational minimum define option:</p> <ul style="list-style-type: none"> ■ 802.11 – Pertains to wireless LANs and provides 1 - or 2-Mbps transmission in the 2.4-GHz band

		<ul style="list-style-type: none"> ■ 802.11a – an extension to 802.11 that pertains to wireless LANs and goes as fast as 54 Mbps in the 5-GHz band. ■ 802.11g – Pertains to wireless LANs and provides 20+ Mbps in the 2.4-GHz band. ■ 802.11b – 802.11 high rate WIFI is an extension to 802.11 that pertains to wireless LANs and yields a connection as fast as 11 Mbps transmission in the 2.4-GHz band
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5.17 EPABX

Table 5-17: Hardware requirement of EPABX

No.	Item	Requirements
1	Technology	PCM-TDM , IP, Non-blocking
2	Type of Interface	ISDN interface for digital, basic interface for Analog lines
3	No. of lines - ,ISDN PRI lines & Analog / Digital Extensions	2 PRI, 32 Extensions (IP / Analog / Digital)
4	Type of Extension Support	Analog , Digital and IP
5	Expansion of Extensions	Multiples of 8 / 16
6	Contact centre Expansion available (Max. capacity)	It must support at least 32 Call centre Agents
7	Max. loop resistance for analog trunk lines	1200 ohms at –48 Volts DC
8	Other	<ul style="list-style-type: none"> • ISDN supplementary services for Digital phone • Support for digital trunk lines • Working on 230v AC mains and DC voltage • Support for ACD call centre with CTI and advanced call routing
9	Design of EPABX System	Rack mountable
10	Conferencing	To be configurable as required

5.18 Landline Phone

Table 5-18: Hardware requirement of Landline phone

No	Item	Requirements
1	Headset	Port for Head set (Headset also to be provided)
2	VoIP Protocol	SIP V2
3	PoE	IEEE 802.3af or better
4	Supported Protocols	SNMP, DHCP, DNS
5	Codecs	G.711, G.722 including handset and speakerphone
6	Speaker Phone	Full duplex speaker phone with echo cancellation speaker on/ off button, microphone mute
7	Volume control	Easy decibel level adjustment for speaker phone, handset and ringer
8	Phonebook/Address book	Minimum 100 contacts

9	Call Logs	Access to missed, received, and placed calls. (Minimum 20 overall)
10	Clock	Time and Date on display
11	Ringer	Selectable Ringer tone
12	Directory Access	LDAP standard directory

Digital Calling VoIP & EPABX including 2 – PRI

The system shall support minimum 100 IP Phones with at least 50 concurrent sessions with features like –

- Provide reports for calls based on records, calls on a user basis, calls through gateways etc.
- Able to add bulk add, delete, and update operations for devices and users
- Session Initiation Protocol (SIP) Trunk support
- Centralized, configuration database, Web based management
- Lightweight Directory Access Protocol (LDAP) directory interface
- Facilities to users like Call Back, Call Forward, Directory Dial, Last number Redial, etc.
- Calling Line Identification

Table 5-19: Hardware requirement of VoIP and EPABX

No	Item	Requirements
1.	Technology	PCM-TDM , IP, Non-blocking
2.	Interface	Should support all telecom interfaces in Indian Telecom Service provider offerings
3.	Type of Interface	ISDN interface for digital, basic interface for Analog lines
4.	No. of lines - ,ISDN PRI lines & Analog / Digital Extensions	2 PRI, 32 Extensions (IP / Analog / Digital)
5.	Type of Extension Support	Analog , Digital and IP
6.	Expansion of Extensions	Multiples of 8 / 16
7.	Run Distance	Not less than 800 meters. on 0.5mm dia. Cable
8.	Max. Loop resistance for analog trunk lines Extensions	2500 ohms including telephone
9.	Requirement at the time of supply	02 ISDN PRI, 24 Analog Ports & 8 Digital extension ports. Expected to handle at least 30 external lines.
10.	Contact centre Expansion available (Max. capacity)	It must support at least 16 Call centre Agents
11.	Max. loop resistance for analog trunk lines	1200 ohms at –48 Volts DC
12.	Other	<ul style="list-style-type: none"> • ISDN supplementary services for Digital phone • Support for digital trunk lines • Working on 230v AC mains and DC voltage • Support for ACD call centre with CTI and advanced call routing
13.	Design of EPABX System	Modular with universal slots, Wall/Rack mountable
14.	Conferencing	5 party conferencing to be provided (to be configurable dynamically)

5.19 Laser Printer (A3, A4)

Table 5-20: Hardware requirement of Laser printer (A3, A4)

No	Item	Requirements
1.	Print Speed	Black: 16 ppm or A3, 24 ppm or above on A4 Color : 8 ppm or above on A3, 12 ppm or above on A4
2.	Resolution	600 X 600 DPI
3.	Memory	8 MB or more
4.	Paper Size	A3, A4, Legal, Letter, Executive, custom sizes
5.	Paper Capacity	250 sheets or above on standard input tray, 100 Sheet or above on Output Tray
6.	Duty Cycle	25,000 sheets or better per month
7.	OS Support	Linux, Windows 2000, Vista, 7, 8, 8.1
8.	Interface	Ethernet Interface
9.	Other requirement(s)	Shall have the ability to Scan, Send and Receive Fax

5.20 All in One Printer (Print, Copy & Scan)

Table 5-21: Hardware requirement of All in one printer

No.	Item	Requirements
1	Output	Black and white
2	Product type	Laser printers
3	Functions	Print, scan and copy
4	Ports	1 Hi-Speed USB 2.0; 1 Fast Ethernet 10/100Base-TX; 1 Wireless 802.11b/g/n
5	Network ready	Standard (built-in Ethernet, WiFi 802.11b/g/n)
6	Connectivity, standard	1 Hi-Speed USB 2.0; 1 Fast Ethernet 10/100Base-TX; 1 WiFi 802.11b/g/n
7	Display HP	2-line LCD (text)
8	Scan speed (normal, letter)	Up to 7 ppm (b&w), up to 5 ppm (color)
9	Scan speed (normal, A4)	Up to 7 ppm (b&w), up to 5 ppm (color)
10	Print speed black (normal, letter)	Up to 21 ppm
11	Print speed black (normal, A4)	Up to 20 ppm
12	Print speed	Print speed up to 21 ppm (black)
13	Copy speed (black, normal quality, A4)	Up to 20 cpm
14	Copy speed black (normal, letter)	Up to 21 cpm
15	Power Consumption	465 watts (Printing), 110 watts (Copying), 2.2 watts (Ready), 0.7 watts (Sleep/Auto-Off), 0.2 watts (Manual Off)
16	ENERGY STAR® certified	Yes

No.	Item	Requirements
17	Scan Resolution, Hardware	Up to 1200 x 1200 dpi
18	Enhanced scanning resolution	Up to 1200 dpi
19	Scan Resolution, Optical	Up to 1200 dpi
20	Memory	128 MB

5.21 Workstation for AVL & PIS

Table 5-22: Hardware requirement of Workstation for AVL & PIS

No	Item	Requirements
1.	CPU	Quad core CPU with 8 threads or equivalent or better
2.	Memory	8 GB DDR4 or better
3.	Hard-Disk Drive	512 GB SSD or better
4.	Display	Two number 21”-inch LCD / LED Display
5.	Display ports	4 Display Port / mini Display Ports Toolkit/Stand to install the dual monitors
6.	GPU	Base clock: 1290 Mhz or better Number of cores: 768 or better VRAM: 4GB or better Display connectors: DP 1.4, HDMI 2.0b, dual link-DVI multi- monitor support Max resolution: 7680 x 4320 @ 60 Hz or better
7.	Keyboard	Wired keyboard with 104 keys
8.	Mouse	Wired Optical with USB interface
9.	Ports	USB Ports including 2 USB 3.0 Ports and audio ports for microphone and headphone
10.	Cabinet	Mini Tower.
11.	Operating system	Windows 10 64-bit operating system
12.	Software Tools	Microsoft Office 365 or equivalent
13.	Antivirus	To be provided

5.22 Indoor Fixed Dome Camera at Command Control Centre

Table 5-23: Hardware requirement of Indoor fixed dome camera at CCC

No	Item	Requirements
1.	Video Compression	H.264 / H.265 or better
2.	Video Resolution	1080p or better
3.	Frame rate	Min. 25 fps
4.	Image Sensor	1/3” Progressive Scan CCD / CMOS
5.	Lens Type	Varifocal, IR Correction Full HD lens compatible to camera imager

6.	Lens#	Auto IRIS 2.8-10mm
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No	Item	Requirements
7.	Multiple Streams	Dual streaming with 2 nd stream at minimum 720P at 30fps at H.264 individually configurable
8.	Minimum Illumination	Colour: 0.1 lux, B/W: 0.01 lux (at 30 IRE)
9.	IR Cut Filter	Automatically Removable IR-cut filter
10.	Day/Night Mode	Colour, Mono, Auto
11.	S/N Ratio	≥ 50 dB
12.	Auto adjustment + Remote Control of Image settings	Colour, brightness, sharpness, contrast, white balance, exposure control, backlight compensation, Gain Control, Auto back focus
13.	Wide Dynamic Range	True WDR upto 80 db
14.	Audio	Full duplex, line in and line out, G.711, G.726
15.	Local storage	microSDXC card 128GB (Class 10) or better In the event of failure of connectivity to the central server the camera shall record video locally on the SD card automatically. After the connectivity is restored these recordings shall be automatically merged with the server recording such that no manual intervention is required to transfer the SD card based recordings to server.
16.	Protocol	HTTP, HTTPS, FTP, RTSP, RTP, TCP, UDP, RTCP, DHCP, ONVIF Profile S & G
17.	Security	Password Protection, IP Address filtering, User Access Log, HTTPS encryption
18.	Intelligent Video	Motion Detection & Tampering alert
19.	Alarm I/O	Minimum 1 Input & Output contact for 3 rd part interface
20.	Operating conditions	0°C to 50°C
21.	Casing	NEMA 4X / IP-66 rated & IK 09
22.	Certification	UL / CE / FCC
23.	Power	802.3af PoE (Class 0) and 12VDC/24AC

5.23 UPS Parallel Redundant

UPS Room

All the required UPS for CBS-CCC shall be installed in the dedicated UPS room in control center building. This room shall be under surveillance and restricted area. All the entry & exit log shall be maintained using automatic system for audit.

The grounding system for the data center shall not just for protection against lightning strike but also it shall be an active functioning system that provides protection for personnel and equipment. Surges that are not properly dissipated by the grounding system introduce electrical noise on data cables.

Table 5-24: Hardware requirement of UPS

No.	Item	Requirements
1.	Input voltage	■ Commercial Power generally but with existing condition of power failure, instantaneous power failure and voltage fluctuation
2	UPS	■ Three (3) hours or longer backup power supply for Equipment in CBS Command Control Centre. ■ Ability to shutdown equipment safely when low battery. ■ Ability to start up equipment safely when restoration of AC power. ■ Protection for voltage fluctuation and voltage spike. ■ Output: AC 230 V / 50 Hz sine wave, constant voltage and constant frequency. ■ Long life battery to meet the Design Life. ■ Output condition shall meet equipment to be supplied by the Contractor. ■ Applying appropriate measures in order to be available even in severe environmental conditions outdoors.

6 Communication Requirement

Table 6-1: Communication Requirements of CBS CCC

No.	Requirements
1.	■ Communication requirements between the roadside equipment and the system server of each subsystem are specified in the requirement of each subsystem.
2.	■ Communication for the replication from physical server environment to the cloud environment shall be a fibre network (Broadband Service) provided by a single communication company.
3.	■ C2C (Centre to Centre) Communication between Traffic Information and Management System Command Control Centre (TIMS-CCC) and CBS Command Control Centre (CBS -CCC) shall be a wired network (MPLS VPN) by a single communication company.

7 Installation Requirement

The Contractor shall make the provision for necessary civil, foundation, earthing, necessary cable conducting, manhole, Power supply, redundant communication, new meter connection, quality, safety and last mile connectivity etc. to meet the functional requirement intended for the system.

The Contractor shall obtain necessary permission from respective agency.

The followings shall be considered installing equipment in CBS Command Control Centre. The Contractor shall prepare the detailed equipment installation layout drawings and obtain approval of it by the Employer.

- Conduct installation of the equipment with prudent consideration to earthquake-resistance.
 - A space should be secured behind Video Wall for heat releasing and maintenance work.
 - All cables should be installed with proper cable wiring arrangement structure in order not to disturb the flow line of users.
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Chapter 3-2 Requirements of Computer Aided Dispatch / Automatic Vehicle Location

1 General

- (a) Each bus shall be equipped with an On-Board Unit (OBU) for location tracking that incorporates cellular data communications and sends frequent periodic location reports to the central operations management system at the CBS Command Control Centre (CBS-CCC).
- (b) These periodic location reports will provide ongoing information about current traffic speed on key road segments, to serve as traffic probes data input to other systems.
- (c) The CCC fleet operations management software will support the operation and effective use of a Computer Aided Dispatch / Automatic Vehicle Location (CAD/AVL) system. This will enable tracking of the route and schedule adherence for each vehicle, and the management/logging of incidents.

2 System Configuration

The system configuration of CAD/AVL is shown in the figure below.

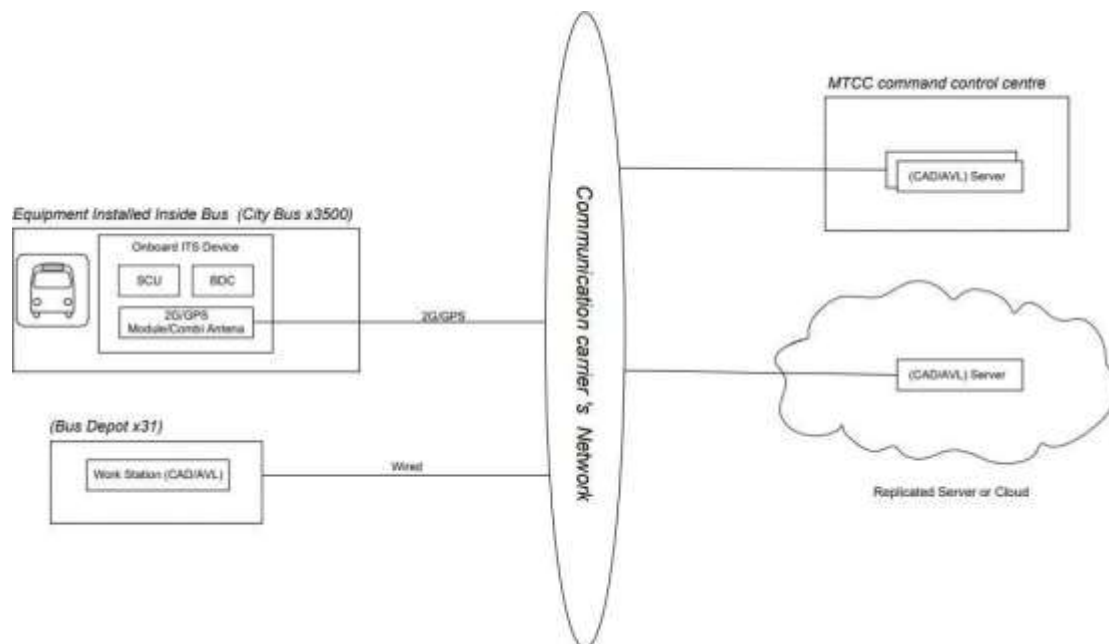


Figure 2-1: System Configuration of CAD/AVL

Following are the typical integration with proposed system with other system being implemented in MTC.

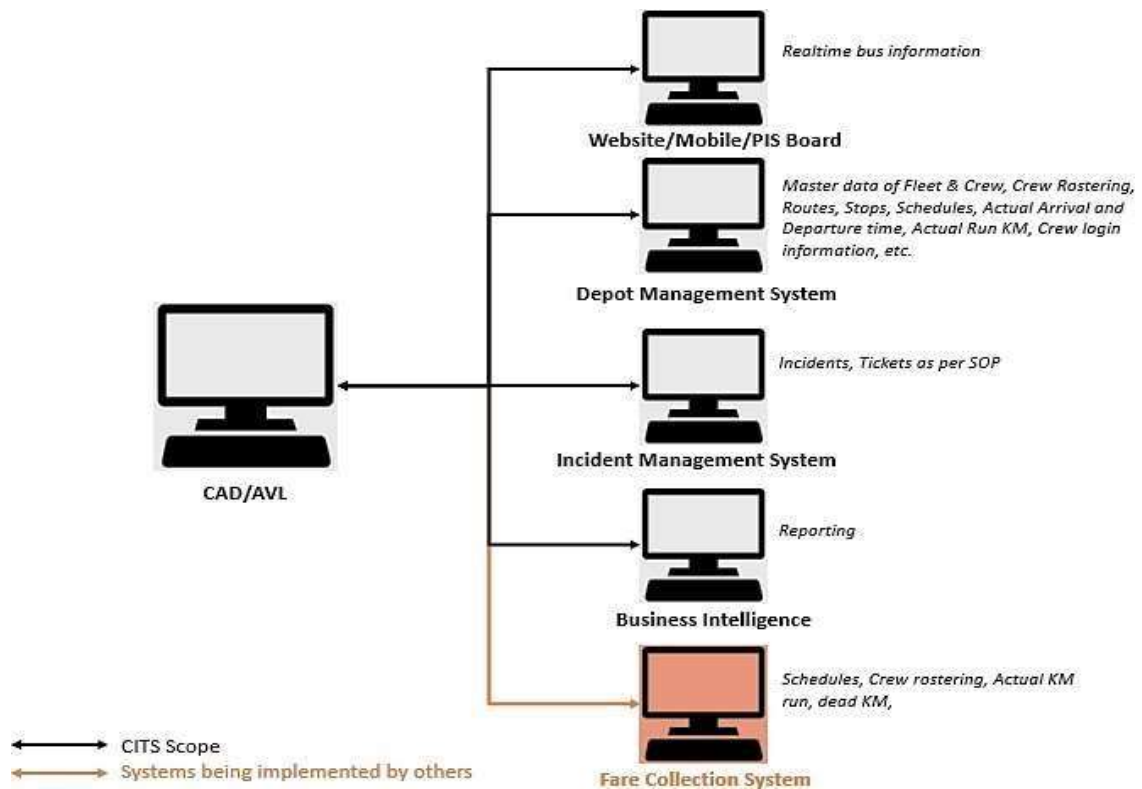


Figure 2-2: Typical Integration of CAD/AVL System with other systems

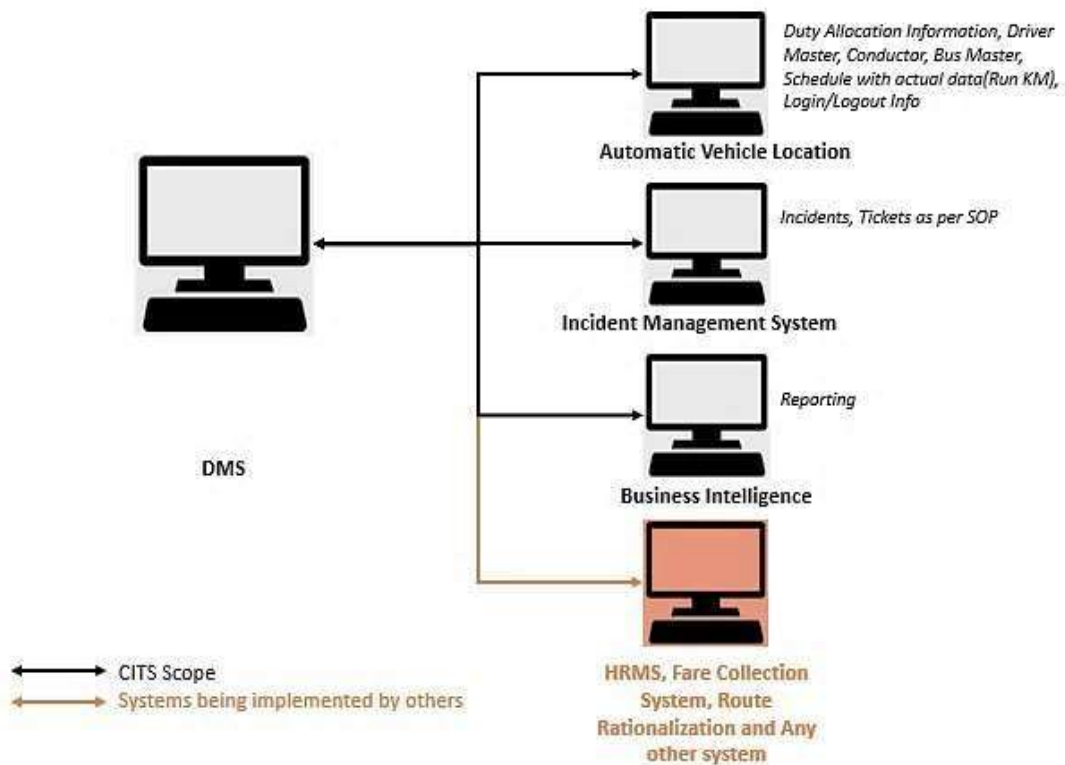


Figure 2-3: Typical Integration of Depot Management System with other systems

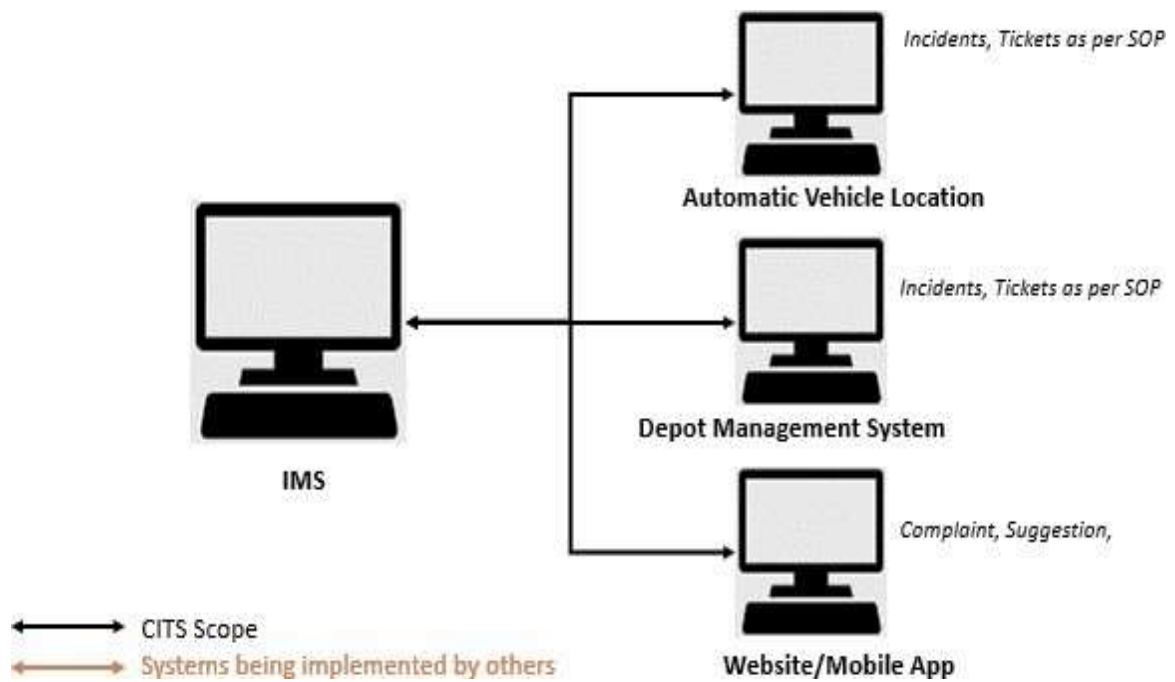


Figure 2-4: Typical Integration of Incident Management System with other systems

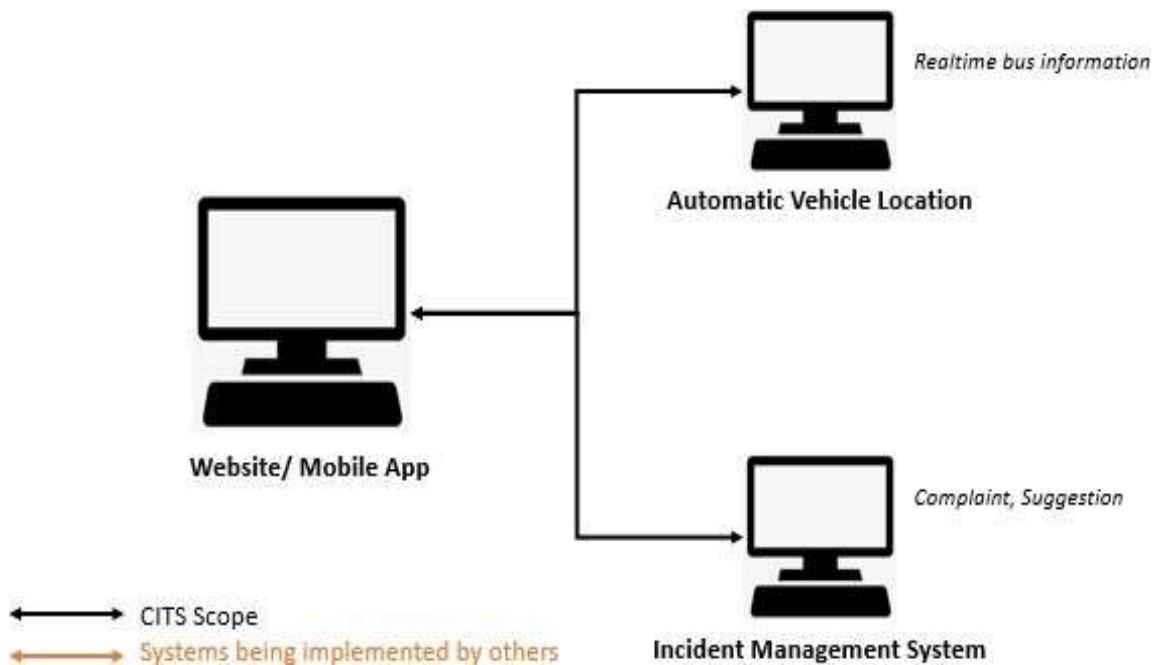


Figure 2-5: Typical Integration of Website & Mobile App with other systems

3 Equipment Location and Type

The onboard ITS device of CAD/AVL will be installed inside 2940 city buses of MTC. There will be additional 560 onboard ITS devices will be supplied and installed by another agency to be integrated by selected contractor with CAD/AVL, PIS and DMS.

4 System Functional Requirement

Table 4-1: System functional requirement of CAD/AVL

No.	Requirements
	GENERAL
1.	Contractor shall conduct a detailed study of the ground situation and understand all aspects of rolling stock, infrastructure, operations, and management required for the various components of CAD/AVL.
2.	System shall allow role-based access and shall be web-based application.
3.	System shall provide read and write access for dispatcher to view and edit information
4.	All active devices supplied as a part of the AVL System shall have self-diagnostic capabilities which can be initiated from the equipment and also remotely from the central server at a pre- defined time each day (configurable) to know and generate the status and health of the equipment.
5.	All applications proposed for City Bus System scope shall be web based applications.
	CAD/AVL CENTRAL SOFTWARE
6.	Contractor shall provide all software and hardware that comprise the overall central system, including the required number of licenses for all users. The CAD/AVL software shall be provided outright with perpetual, royalty free license.
7.	All data shall be the property of the Employer and shall be immediately available to the Employer.
8.	All servers shall be fully redundant and capable of automatic failover without administrator intervention.
9.	System shall allow dispatcher to send message to multiple fleet vehicles simultaneously.
10.	System shall allow dispatcher to select one vehicle, multiple vehicles, all vehicles, depot wise and service wise.
11.	All workstation application software shall have the latest available operating system platform.
12.	Preceding three years of data shall be retained in a historical database for use by management and other Employer's staff to plan and assess system performance, and to address inquiries, conflicts and related issues.
13.	The CAD/AVL software shall be installed on CCC workstations, and at required off-site locations for managerial staff to review the operations.
14.	The CAD/AVL Application software shall be LAN based at the CCC and web-based versions shall be available for offsite access. If the Bidder proposes web-based Software for the CCC, the Bidder shall show that the access speeds are satisfactory for the system requirements.
15.	All CAD/AVL data shall be stored in a manner that allows direct access through the software for at least the preceding 180 days. Utilities shall be provided to support archive and restore functions for older data.
16.	The onboard computer will send the location data every 10 seconds or at a user configurable value, which central system software shall capture and process. Various alerts, to be finalized in the design stage, shall be shown to the dispatcher in real-time to help support operations.
17.	GPS location data shall be transmitted using a 3G/GPRS connection to the central system software within 1 minute for all the vehicles.
18.	The CAD/AVL system shall transmit the location data every 10 seconds to the probe processing module of Integrated Traffic Management System (ITMS) of Chennai Traffic

No.	Requirements
	Information and Management System Command Control Centre (TIMS-CCC) with suitable data format for the module.
19.	During project implementation or maintenance, if the Employer find the cellular service used by the Bidder is not satisfactory, the Contractor shall migrate the SIMs to a better service provider approved by the Employer at no additional cost.
20.	The CAD/AVL system shall integrate with Depot Management System to maintain and receive updates for schedule, crew and fleet information.
21.	If crew is on vacation, system shall able to identify his/her vacation and notify to operator to replace the crew.
22.	Vehicle maintenance shall seamlessly integrate with Depot Management system so that no redundancy of master data exists between the systems.
23.	The vehicle status list (e.g., headway adherence) shall be displayed capable of being sorted on any data field by the individual dispatcher.
24.	Two-way voice communication from CCC to Vehicle: Central system software shall allow the through software. Dispatchers at CCC shall use headphones to talk to the crew.
25.	Two-way voice communication from Vehicle to CCC: All the calls shall land in EPABX/VoIP or similar Employer approved system so that multiple calls at CCC can be handled by the dispatchers.
26.	All the two-way communication cost shall be borne by the Contractor for the period of the project including Maintenance period.
27.	CAD/AVL system shall have System Audit trail feature.
28.	<p>CAD/AVL system shall interface with other ITS systems mentioned below and in the document. Contractor need to share the relevant data generated from CAD/AVL and DMS with other systems mentioned below and receive & integrate with data that are required during the design stage.</p> <ul style="list-style-type: none"> • Incident Management System • Human Resource Management System • Fare collection system • Route rationalization • Maintenance management system • Workshop management system
29.	AVL system shall provide centre-to-centre communications with ATCS (Signal) system when vehicles (MTC buses, emergency vehicles, VIP vehicles, etc.) traverse preset geo-fences. The AVL system shall provide information for the signal system to initiate Transit Signal Priority in a timely manner as per operational requirements.
	Data Sharing with Traffic Information & Management System (TIMS)
30.	<p>CAD/AVL system shall be capable of sharing the bus probe data in GTFS format with the probe processing module of Integrated Traffic Management System (ITMS) of Chennai Traffic Information and Management System Command Control Centre (TIMS-CCC). The bus probe data shall contain the following data items as minimum.</p> <p>(a) Minimum Items to be shared</p> <ul style="list-style-type: none"> ✓ Bus ID ✓ Positioning Time (Time stamp at GPS device) ✓ Location Data (Longitude and Latitude) ✓ Ignition Status ✓ Vehicle Speed ✓ Harsh Braking ✓ Geofence triggers ✓ Vehicle Health & Monitoring parameter ✓ etc. <p>(b) Minimum Transmission Frequency</p> <ul style="list-style-type: none"> ✓ 10 seconds or less <p>(c) Data Format</p> <ul style="list-style-type: none"> ✓ Suitable format for the probe processing module of TIMS
	MAPS

No.	Requirements
31.	The CAD/AVL system shall incorporate maps to support the functionality, comprised of a selection of individually selectable theme layers (e.g., stations, streets, names, water features, parks, major buildings). The base map shall be Google Maps or similar quality.
32.	The CAD/AVL system shall have a smart search feature to filter the data shown by the software.
33.	The Bidder shall develop a GIS based base map for the project at a scale of at least 1:2500 or better resolution operationally.
34.	The system shall include mechanisms to allow for periodic independent updates to the central software maps.
35.	Fleet icons on the Map shall show the direction of travel of each bus in real-time.
36.	The client shall be able to develop additional overlay map layers to the external source map that shall include polygons (e.g., municipal boundaries, fare zones), lines (e.g., route traces) and points (e.g., landmarks, transfer locations, time-points, stops), with the color, shape and thickness being selectable.
37.	Map shall have a tool to measure the distance through mouse clicks.
38.	Software shall allow authorized Employer staff to create, modify and delete the Points of Interest and Geofencing on the Map.
39.	The Employer shall help to identify the locations of bus stops, bus stations, terminals, depots, etc. to the Contractor. Bidder is responsible for carrying out the necessary surveys and bearing the cost of equipment, persons, transportation, etc.
40.	The software shall allow users to view the map, including a selectable combination of the source map layers and new layers, at various user-defined zoom levels.
41.	The system shall receive location reports from each vehicle. The system shall use the time stamped location reports in combination with schedule data to derive the current schedule adherence status.
42.	Application shall have reasonable filters to track the vehicle movement in real time
43.	Application shall allow dispatcher to select multiple vehicles using mouse clicks. Dispatcher shall be able to send group messages or conduct voice call to the selected vehicles in one shot.
44.	Application shall be capable to figure out where bus had deviated from and rejoined the defined route and show this on the map.
45.	The system shall receive and store latitude and longitude information together with the associated schedule adherence, stamped with date, time, vehicle, schedule, route, and store this data.
46.	Information shown along with the vehicle on the map shall be user selectable. The User shall have the option of selecting to display vehicle number, route, schedule, speed, delay time, etc. with the vehicle. The actual parameters are to be defined during design stage by Bidder through discussion with the Employer.
47.	The display icon of the bus on the map shall provide an indication if the latest reported location being displayed is older than the reporting interval or not.
48.	<p>The display icon of the bus on the map shall provide an indication in different colour based on current bus status</p> <ul style="list-style-type: none"> • On time • Late • Early • Over speeding • Route deviation • Last report older than reporting interval • SOS Alert <p>The details to be defined during design stage by Bidder through discussion with the Employer.</p>
49.	The system shall track headways for each individual route.
50.	Schedule Adherence shall be based on Planned Schedule vs. Actual schedule using mainly automated geofence data of trip ends. Additional, time-based adherence of schedule should

No.	Requirements
	be implemented to ensure Operational challenges that are commonly seen in Indian conditions.
51.	Based on configurable thresholds, the system shall use the observed headways to report to dispatcher using a real-time alert when headways are shorter or longer than desired range of headway.
52.	The system shall highlight the vehicle IDs of those vehicles operating with out of tolerance headway, using tabular and map displays to indicate the current headway adherence status.
53.	The tabular display entries and the map display symbols for these vehicles shall use distinct and configurable colour codes for short headways and long headways status.
54.	Map should refresh the vehicle location on every 10 seconds interval. The application shall allow the Employer to reconfigurable this reporting interval at any time without need for code or program change.
55.	The system shall provide a real-time output of the current location and schedule adherence for all fleet vehicles, for use by the stop arrival prediction software.
56.	More than 70% of the predictions for Estimated Time of Arrival made 15 minutes before the bus arrival shall have accuracy between -2 to 7 minutes. The thresholds shall be reassessed during operations for better passenger confidence on the predictions.
57.	ETA should be shown for buses across Trips based on selected schedule.
58.	Estimated Time of Arrival shall be calculated and displayed on the PIS display board located at terminals, bus stops/shelter and interchanges in real time.
59.	In case of vehicle breakdown or other incident being logged by the dispatcher, the system shall record the event and send an alerting SMS to configured persons.
60.	Contractor shall document and provide to the Employer the communications protocols, command sets and message formats used in all interfaces.
61.	On left/right click of the mouse, the following vehicle information, at a minimum, shall show on the Map: <ul style="list-style-type: none"> • Vehicle Number • Contact no of Crew • Current Trip/Schedule no • Current Delay • ETA for minimum of next 3 stops • Last stop • Next approaching stop • Last GPS time stamp • Current Vehicle status • Current Speed
62.	All the alerts shall meet MTC business requirements. Various alert types as explained below, shall be discussed and finalized during design stage.
63.	Alerts to the dispatchers shall be configurable by authorized MTC staff.
64.	Dispatchers shall have ability to filter or sort the alerts by type.
65.	By double clicking the vehicle icon the CAD/AVL application shall provide the history of all alerts throughout that day for that vehicle.
66.	Alert window shall have option to show recent alerts for specified preceding time, that entire day or for preceding 3 months.
67.	The CAD/AVL Application GUI and map should interface to provide extensive alerts required for real-time operational support. If required the following alerts shall be sent by Email and SMS to the configured Employer staff (ex: Service and Maintenance Alerts). For critical alerts the system will also generate an audio alert. Following is the tentative list, which may be updated or added to during the design and implementation period: <ul style="list-style-type: none"> I. Critical Alerts (SOS) <ul style="list-style-type: none"> a. Ambulance Required b. Accident/Breakdown/Fire c. Bus stopped idle for x minutes during the Trip (Time must be configurable by the Employer) II. Major Alerts

No.	Requirements
	<ul style="list-style-type: none"> a. Bus running without Schedule/Trip on the Road b. Route Deviation Alerts c. Schedule Adherence Alerts – colour coded by gap time d. Bus Bunching Alerts e. Speed Violation <p>III. Vehicle Status Alerts</p> <ul style="list-style-type: none"> a. Over Speeding b. Tamper Alert c. Harsh Acceleration d. Harsh Braking <p>IV. Service and Maintenance Alerts</p> <ul style="list-style-type: none"> a. Crew license expiry b. Vehicle FC renewal c. Vehicle routine maintenance d. Vehicle insurance and road permit
68.	<ul style="list-style-type: none"> • The CAD/AVL Central Software shall display the following information, at a minimum, for a selected stop(s): • Stop ID; • ETA for the next ‘x’ number of buses, where x is configurable through the application. • Routes servicing the stop; and • Number of buses that shall arrive as per Schedule in the next x minutes, where x is configurable through the application.
69.	The Alerts shall be easily identified on the map through double-clicking of the alert. Location playback features shall be available on clicking of Alerts.
	LOCATION PLAYBACK
70.	The dispatcher shall be able to review on the map display the chronological sequence of reported locations for a specified vehicle over a specified time period.
71.	The software shall provide controls to view the entire sequence of reported locations from the beginning of the time period or to step through the sequence incrementally forwards or backwards.
72.	The system shall allow replay for a single vehicle, selected set of vehicles or all vehicles on the selected map view for selected time period. Selection can be time period, or area in which vehicles arrive or a combination of both.
73.	System shall include multiple features for location playback, to allow variable speeds and time period selections for ease of replaying.
74.	The system shall allow selection of any time period for playback using the historical data.
75.	Replay functionality shall have necessary filters for dispatcher to find the vehicles
76.	The replay data shall include location and schedule/headway adherence data.
77.	All users accessing the CAD/AVL software shall be able to access the playback function.
78.	Replay functionality to support vehicle with or without an assigned schedule/trip.
79.	The system shall allow the ability to use playback without exiting from the current CAD/AVL operational view.
80.	The system shall be able to store a playback in a format that can be exported for viewing on any computer.
	Data Logging and Retrieval
81.	All incoming and outgoing data shall be stored for retrieval, analysis, display and printing.
82.	The system shall allow all such data to be retrieved, even if it has been archived.
83.	This historical information shall include all reported and derived data for vehicles (including at minimum the date/time, vehicle, schedule, route, trip, location data, schedule adherence data, headway adherence data, station/stop arrival predictions); and all central software user logons and logoffs.
84.	The system shall include a means of archiving transaction data, or restoring data from an archive, while the system is in operation.
85.	It shall not be necessary to shut down the database to perform a successful back-up operation.

No.	Requirements
86.	The stored data shall enable accessing the historical data from both the online and archived storage, and selective sorting and retrieval based on user-specified criteria for any of the fields.
87.	Historical data shall be read-only with modification only permitted to individual pre-defined fields, with prior approval from the Employer
CAD/AVL GUI REQUIREMENTS	
88.	The central system shall be delivered with a fully functioning Graphical User Interface (GUI).
89.	The GUI shall be based on standard Windows controls or equivalent.
90.	Scheduling and rescheduling shall be very convenient for day to day operations for the dispatcher.
91.	Dashboard: Multiple dashboards shall be created based on dispatcher category. At minimum preceding month, preceding week, preceding day, current day. The dashboards shall be made available as soon as dispatcher login and there should be option to include dashboard access in the menu.
92.	All screens with paging data shall open and populate with the initial data in 3 seconds and thereafter page updates shall be retrieved within 1 second.
93.	Dragging the cursor bar for a scrollable list shall cause instantaneous redisplay of the list in time with the movement of the cursor bar.
94.	A single screen shall show the vehicle no, vehicle status, last stop, and last GPS timestamp received
95.	All the buses within the map view shall be shown concurrently in the GUI with both static and real-time data
96.	Multiple configurable views using the GUI shall be available for the dispatcher, available for retrieval through a dropdown list.
97.	The hover features should be present giving an indication of the main vehicle movement characteristics in real-time, which shall include at minimum the current speed, distance travelled, next nearest stop, delay if any, trip number etc. These parameters should be also configurable easily, to display system features as required by the Employer.
98.	CAD/AVL GUI shall use line diagrams to show dynamic status of all vehicles along a selected route.
99.	Various master data files should be available through the CAD/AVL GUI. These include but not limited to: I. Schedule Master II. Route Master III. Bus Stop Master IV. Depot Master (for future requirements) V. Crew Master VI. Onboard Computer Master VII. PIS Master VIII. Landmark Master
PREDICTION SOFTWARE REQUIREMENTS	
100.	The system shall use the real time location and schedule adherence data to create a continuously updated table, XML data feed and GTFS real-time data stream of the last reported location for all vehicles and the next arrival predictions within the Employer's configurable upcoming time window for all stations/stops
101.	The system shall provide this data table and XML data feed and GTFS real-time data feed to which the Employer and designated third parties have the right to perpetual and royalty-free access, for the purposes for integration with future Passenger Information System (PIS) or other public information methods and importing data into the long term database.
102.	The Bidder shall also provide a data dictionary and Entity Relationship Diagram for the data tables and XML schema documentation.
103.	The information required by the algorithm(s) shall be manually entered into a prediction support database by the Bidder.
104.	The system shall allow the user to configure the prediction support database values.

No.	Requirements
105.	A system report providing accuracy predictions stratified by minutes in advance of the arrival, filtered on a stop and time period basis, shall be provided to enable accuracy assessment during and after the implementation. With such a report, the Bidder shall still be required to assist with sufficient field data collection to validate the system prediction accuracy report, as well as with efforts to use the report data to maximize the accuracy of the arrival predictions.
SYSTEM SECURITY REQUIREMENTS	
106.	The Central System & CCC Workstation shall only be accessible by authorized persons, controlled using login and password protection.
107.	It shall be possible to create multiple user classes with different privileges.
108.	The system shall maintain a transaction log that records when each user accesses each report, any edits and changes to the database, and the system logon and log-off times.
109.	The transaction log shall maintain this information for a minimum of one year.
110.	The system security shall provide features to maintain data integrity, including error checking, error monitoring, error handling, and encryption.
111.	Features shall be provided to automatically detect, correct and prevent the propagation of invalid or erroneous data throughout the system.
112.	All systems, sub-systems and devices shall only allow access to authorized user classes.
113.	All security breach detections shall be confidential, and accessible only to users of the appropriate class.
114.	The Central System shall be capable of data communication with all system components in real-time.
115.	The central system shall update its date and time by applying time synchronisation to servers using the internet and using this to in turn update the date and time on all onboard computer and PIS Displays.
116.	The central computer system shall manage all device activity including data storage and processing.
117.	All active equipment shall have an internally maintained date and time clock synchronized at a time interval via the communications controller with the Central System date and time clock.
118.	The time synchronisation application in the device shall have the capability to adjust the minimum time interval to update itself with the central system time and date, and shall be able to update time every minute (configurable) with the central system.
119.	All mobile equipment (onboard computer) shall operate with a real-time data connection to the central system via the communications (GPRS) network
120.	If the data connection to the central system is temporarily lost, all equipment shall seamlessly switch to an offline mode in which all data is temporarily stored in internal memory and transmitted to the central system as soon as the data connection is re-established.
121.	All equipment shall have sufficient memory to operate in offline mode, with no loss of data, for not less than 168 hours.
122.	It shall be possible to “future-date” messages to PIS systems so that they can be uploaded ahead-of-time and automatically displayed during the planned date and time.
123.	The central software shall provide over-the-air updates & firmware updates to all devices, separate from other immediate critical updates.
124.	The systems shall be driven by configurable parameters and shall provide the flexibility for maximum configuration. The configurations shall consist of, but not be limited to: <ul style="list-style-type: none"> a. Time based messages b. User Groups and user privileges c. Addition & deletion of onboard computer, PIS nodes, user groups, users d. Configurable messages in English and Tamil languages e. Reports access
125.	The system shall handle all exceptions. Exceptions can be, but not limited to: <ul style="list-style-type: none"> a. Message not being displayed on the PIS

No.	Requirements
	b. Triggers for panel opening of any equipment c. Default message shall be configurable in case of the lost central connectivity
126.	The system shall handle all degraded conditions, including but not limited to: <ul style="list-style-type: none"> a. Any supplied equipment not functional b. Power failures c. Data Connection lost d. Central Server down
MAINTENANCE MODE – OPERATIONAL REQUIREMENTS	
127.	The Central system and all the equipment (on-board ITS equipment, PIS displays in terminals, bus stops/shelters, etc.) shall support a maintenance mode for use during repair, replacement and testing of equipment.
128.	The maintenance mode shall have feature to be activated by only a person having the highest user privilege in terms of system operations.
129.	Logins and logouts shall be transmitted to the central system, along with associated Date/Time, employee ID, equipment ID etc.
130.	It shall be possible to upgrade the firmware/software of the onboard computer from the central server using the communication network.
131.	System shall allow update for configuration changes at multiple fleets onboard computer over the air.
132.	The Employer shall be the owner of all system data and able to use the central system to export transactions data for processing/analysis using other software.
133.	Data received from system devices shall be maintained at the original level of transactions and not be aggregated, consolidated, or combined within the database.
134.	Sufficient data storage capacity shall be provided in the central system to store online a minimum of two years activity data.
135.	All data shall be automatically backed-up daily without human intervention, using the backup devices and media. Bidder shall provide all needed data cartridges, as required during O & M period.
136.	Means shall be provided to automatically archive data older than two years using the archiving media.
137.	The system shall use archived data to process comparative reports, such as but not limited to reports utilizing and comparing data from non-consecutive month periods in two different years, or day-of-week comparisons over multiple month or annual periods.
138.	The transactional database shall store the date/ time stamped details of all information transmitted to the central system from system devices.
139.	In addition to transaction records, the database shall incorporate additional tables to record information of interest, including but not limited to: <ul style="list-style-type: none"> a. Device locations (e.g. PIS Displays) b. Diagnostic/maintenance data (such as error records) c. Exception data (e.g. alarms, memory clears)
SCALABILITY/FUTURE OPERATIONAL REQUIREMENTS	
140.	The central software shall be scalable to accommodate 6000 buses, 5000 bus stop PIS display, 250 PIS boards at terminal, DMS solutions up to 50 depots without any modifications to the central software except minor configuration changes, with the detailsof how scalable the system is provided in the proposal by the Bidder without any additional cost to the Employer. No additional amount will be paid for the software components for the quantity mentioned here.
141.	Employer plans to implement several other service or feeder routes in future, for which the existing central system shall be used, by including only additional hardware for additional buses as per the requirement.
142.	Contractor shall be able to generate all reports separately for every service under operation.
143.	Contractor need to provide additional 1 TB storage to store the data that are received from various other systems like. Fare collection, Route Rationalization, any other application expected to integrate with CAD/AVL, PIS & DMS.
MIS REPORTS REQUIREMENTS (BUSINESS INTELIGENT APPLICATION)	

No.	Requirements
144.	<p>The Contractor shall provide latest version of proven Data analytics/BI tool to analyze and provide the data to MTC in detail. Contractor shall provide details in their proposal related to reports offered and the degree to which they can be configured (at minimum all reports shall be configurable for a specified date/time range and routes or schedules or service type). Summary reports for different levels of management staff shall be designed by Bidder during the design stage. Automated graphs/plots for commonly used data shall be provided in discussion with the Employer. Following are tentative list, this may be updated/added during design and implementation period:</p> <ol style="list-style-type: none"> 1. Schedule adherence at depot, terminal and various selected bus stops/stations 2. Headway adherence/Bus bunching report 3. Active fleet (weekday and weekend) 4. Service hours and mileage 5. Speed violation reports 6. Alerts reports 7. Missed/Cancelled Trip 8. Route Deviation 9. Dead KMs report 10. Vehicle Distance Travelled as per schedule/ trip/ chartered trip 11. Bus stop skipped 12. Improper stop report 13. Daily bus out shedding report 14. Bus breakdown report 15. Depot IN/OUT report 16. Monthly summary reports broken down by system, division, depot, route, bus type, driver, conductor, bus make, etc. 17. Bus Location by date/time, location, and other parameters 18. Driver performance report consisting of bus stop skipping, harsh acceleration, harsh deceleration, over speeding, etc. 19. Fraudulent activity reports with the hardware (Tampering reports) 20. Faults and errors 21. Bus trip reports; 22. System exceptions reports 23. System performance and activity reports 24. Financial reports SLA violation report based on the business rules specified in bus operations tender. 25. Travel time reports between stops. 26. Reports on events that hinder movement of buses. 27. Consolidated GPS analysis report – service provider wise 28. Consolidated GPS analysis report – vehicle wise, depot wise, service wise 29. Historical reports <ol style="list-style-type: none"> a. Employee detail b. Vehicle detail c. Bus stops d. Bus stop names by route
145.	The Contractor shall be able to collect all the required data from the onboard computer to generate the required PIS display data and MIS reports.
146.	The software shall have the capability to generate reports based on exceptions as per thresholds set by the Employer staff for various CAD/AVL components.
147.	Reports shall have summary and detail information based on the Employer needs.
148.	The Contractor shall provide tools to generate ad-hoc / custom reports on stored CAD/AVL data.
149.	All reports must use standard reporting tools similar to Apache Spark, Hadoop, IBM IoT framework, Microsoft Azure, and have the ability to export data into file formats that can be exported to and edited with standard office software (e.g., Microsoft Word and Excel, Adobe Acrobat .PDF)

No.	Requirements
150.	Any portion of the transactional database shall be exportable in standard formats (such as .csv, xls, xlsx, xml, etc.) for analysis in third party programs.
151.	It shall be possible for users to build custom reports from the data in the transactional database with support. The reports should be customizable for various time periods through the dashboard of the reporting system.
152.	A data dictionary shall be provided to the Employer to facilitate development of custom reports.
153.	The Central System shall provide sufficient summarized and detailed data, including features to generate standard reports based on pre-established criteria, as well as as-required reports based on a user-definable set of search criteria.
154.	<p>All reports shall be generated using a query language and standard query engine (to be approved by Employer) that provides flexibility for future updates, and for creation of new reports.</p> <p>BI Analytics capability must be in-built in the platform without usage of additional COTS product or additional integrations</p> <ul style="list-style-type: none"> <input type="checkbox"/> Platform must be capable of providing slice and dicing capability using the visual representations and actions available in the dashboard widget system <input type="checkbox"/> Platform must be capable of analyzing the data coming from different domains and the different sub-systems <input checked="" type="checkbox"/> Platform must have user friendly BI tool for manual as well as automated analytics. <input checked="" type="checkbox"/> Platform must be capable of mashing the data from different domains and different sub-systems, and thus provide cross-domain analysis capability <input type="checkbox"/> The Analytics engine must be an artificial intelligence-based module to maximize business value through advanced machine learning capabilities. The machine learning capabilities must aid in operations management and result in better outcomes. <input type="checkbox"/> Analytics Engine must have automatic Model training and retraining capability and should not have any manual intervention <input type="checkbox"/> Analytics Engine must be able analyze the simulated data, train the models using simulated data and predict the possible outcomes <input type="checkbox"/> Based on data analyzed from multiple data sources of the city, Analytics Engine must provide recommendations which can derive value/outcomes in terms of revenue optimization and cost savings for the city.
155.	Reporting software shall include the ability to generate graphs and charts based on criteria and format defined by the user
156.	All reports shall be generated with configurable time parameters, including as a minimum annual, monthly, weekly, daily, hourly and with user defined start-end date and time ranges
157.	As a minimum, the Central System shall generate required standard reports daily, weekly, monthly, quarterly and annually. These reports shall be available through the CAD/AVL Software.
158.	<p>The Contractor shall provide an ad-hoc reporting function and interface into the data and reports server to allow the Employer personnel to create, execute and receive custom reports without Bidder assistance. An Internet-based interface shall be provided for this function, accessible by the Employer personnel with appropriate permissions. The Employer users shall be able to generate ad-hoc reports and do additional analysis of ridership, revenue and other System data. The Bidder shall enable The Employer staff to generate reports and use the system. Examples of the types of reports include:</p> <ul style="list-style-type: none"> a. Transaction-level reports by stop and for user-defined start and end points; b. Statistical and research reports using user-defined criteria.
159.	<p>It shall be possible to aggregate data (filter) for reporting, at a minimum, by:</p> <ul style="list-style-type: none"> a. Date/Time b. Origin c. Destination d. Location e. Equipment Serial Number f. Vehicle number g. Crew Name

No.	Requirements
	It shall not be necessary that values be consecutive for the purposes of aggregation (e.g. non-consecutive months).
160.	The actual bus operational business rules will keep varying and the Employer shall periodically share these with the selected Bidder, which the Bidder shall reflect in the CAD/AVL application for generating any additional reports during the project period.
161.	The Software shall be capable of establishing automatic periodic (monthly/quarterly/yearly) routines to automatically produce and email standard reports to defined user groups.
162.	The Software shall provide a web-based reporting tool to allow for access from anywhere. The access and views of the reports will be based on role based access control.
163.	Software shall allow The Employer to generate Summary and Detail reports as applicable.
PERFORMANCE REQUIREMENTS	
164.	Server hardware and licenses shall be sufficient for up to 50 dispatcher work-stations to access the central software concurrently, with no loss of performance.
165.	Contractor to arrange and provide application, software and antivirus licenses as per numbers mentioned in system inventory table. If any additional licenses are required as per the system design approved for the Contractor then Contractor to provide necessary licenses without any additional cost.
166.	The central software shall be scalable to accommodate 6000 buses, 5000 bus stop PIS display, 250 PIS boards at terminal, DMS solutions up to 50 depots without any modifications to the central software except minor configuration changes, with the details of how scalable the system is provided in the proposal by the Bidder.
167.	The servers shall have capacity to process 300,000 service transactions/hour
ON-BOARD ITS (onboard computer) Interface with AVL Application	
Single Control Unit (SCU) / Bus Driver Console (BDC)	
168.	Contractor shall provide the end to end support to integrate with central system software. This hardware shall have UBS II or equivalent specification. Following hardware would be supplied: <ul style="list-style-type: none"> • SCU • BDC
169.	The city services are existing buses for which the Bidder shall supply, install and operationalize the SCU, BDC and two-way communication (audio interface) system. The SCU, BDC and audio interface shall be compliant with UBS-II requirements or have equivalent standards that are acceptable to the Employer.
170.	At the onset of the project, the Bidder shall study the power surges on cold cranking of buses using OCR and design the SCU to withstand these surges. A report on the surges in various types of buses shall be provided to the Employer before SCU installation.
171.	The Contractor shall provide for the CBS equipment: <ul style="list-style-type: none"> • Communication protocols: The SCU communications shall be based on open protocols. Contractor shall provide the protocols, API and interface documents to the Employer before system acceptance or when it was asked by the Employer. • Installation: The installation of the CAD/AVL equipment shall be done professionally. The BDC shall be installed such that it is can be comfortably viewed and touched by a range of drivers during vehicle operation. • GUI Customization: BDC GUI shall be customized for the Employer requirements. Customization is for making the BDC support the CBS operations to be undertaken by the Employer, including showing selected information in the local language. • A timer shall be provided with SCU so that the SCU can be switched off after a variable set period (1 minute to 2 hours) after the bus ignition is switched off. The timer shall help protect the life of the bus battery, while ensuring file transfers can be completed in the depot after the bus ignition is switched off.
172.	The onboard computer firmware shall be able to update over the air (OTA) from CAD/AVL central system software at Command Control Center.
173.	Contractor shall understand the MTC requirements and develop the interface for BDC as mentioned below at a minimum:

No.	Requirements
	<ul style="list-style-type: none"> • BDC interface shall mainly be graphical and shall support both the language Tamil and English to be selected between by crew at their convenience. • Login for driver through pin number to be entered using BDC • Route selection function is to be provided on BDC • All driver related route information to be displayed on BDC • Alerts of harsh braking, harsh speed, harsh acceleration, route deviation, speed violation, shall be sending to BDC from central system software. • BDC shall provide basic map of Chennai city and Rural. Using that crew can see the vehicle location. • BDC shall provide a line diagram of the route with a current vehicle location and where the vehicle should be present as per schedule, in real-time. Clear graphical indication of on-time/early/delayed performance shall be provided through colour coded thresholds. • Next stop name with distance • Application shall able to send route and its related information to BDC. Route selection could be automated or manual selection based on MTC business requirement, this would be discussed and finalized during design. • SOS: Multiple SOS messages shall be provided to crew to send to CCC. • Depends on SOS type dispatcher shall be able to acknowledge the SOS received from bus. • SOS interface developed by Contractor shall support that if required SOS messages shall be passed to multiple staff from central system software. • Two way voice communication: interface shall support making two way voice communications from vehicle to CCC or CCC to vehicle. • Two way voice communication: Interface shall support only registered number can make outgoing and incoming call to the vehicle.
174.	The onboard computer shall be able to automatically pull the route information from the central system software depending on the operations schedule associated with a particular bus.
175.	The onboard computer shall send the current location report as determined by the GPS receiver over the 3G/GPRS network to the Central System, at an interval specified by the Employer. The Employer shall be able to choose a location report interval, with a minimum of 10 seconds.
176.	The onboard computer shall detect if the vehicle stops for more than x minutes (configurable) at a location other than a station or a traffic signal or any other pre-defined location and send a time stamped report of this occurrence to the central system. If this occurs when the vehicle is not in cellular data coverage, this report shall be sent as soon as cellular coverage is acquired.
177.	In case of reported vehicular stoppage, the interface shall be able to allow the reasons for such delay and exclude such delays due to unforeseen conditions to be excluded by impacting the penalties of the bus operator. However, such exclusions shall be possible only to be included by the Employer.
178.	SCU is capable to store waypoint data. CAD/AVL central software shall be able to pull the bulk data from multiple SCU.
179.	Contractor shall ensure that selected service provider for the cellular data network(s) shall have complete coverage in Chennai, acceptable to MTC.
180.	Interface shall be developed by the Contractor to integrate the SCU and BDC with central system software to display information in Tamil or in simple enough graphical form that the Crew can comprehend it with minimal training.
181.	Contractor shall provide connectivity between the onboard computer and the existing vehicle CANbus to enable the onboard computer to monitor CANbus messages.
182.	Contractor shall develop and customize the onboard computer application to monitor and interpret all messages on the existing vehicle CANbus, including the ability to configure actions to take to store and/or send data when configured messages are detected.
183.	Data received from the onboard computers as a resulting of this CANbus messages monitoring bus shall be stored by the central software. And shall be transferred for use by vehicle maintenance software provided by others for data processing and analysis purposes.

No.	Requirements
184.	Contractor need to develop and customize onboard computer application to support the integration of following components without any additional cost as on when required. <ul style="list-style-type: none"> • In-bus PIS board • In-bus Surveillance and analytics • Vehicle Health Monitoring and Diagnostic device using CAN bus protocol • In-bus announcement system • In-bus Route boards • Existing Variable Message Boards installed in Chennai
185.	In-bus route boards shall display Expected Time of Departure (ETD) while buses standing at the terminals.
186.	Currently safe city project being implemented in MTC for 2500 buses. Selected bidder is expected to integrate Onboard Computer (SCU) with Mobile NVR installed in the bus to transfer the Video data to control centre where Video Management System is running.
187.	Currently MTC is planning to buy additional buses which will have UBS II specifications similar to SCU and BDC mentioned in this document. Selected bidder is expected to integrate along with this scope of work.
188.	Single Control Unit shall be capable of storing at least 8000 schedules in it.
189.	Change of schedule by crew through BDC shall not be allowed without acknowledgement by the dispatcher/branch manager or designated person of MTC.

5 Hardware Requirement

All hardware equipment shall as a minimum, meet all the requirements listed in the specifications. The equipment's provided shall accommodate to future technological advances which exceeds the minimum requirements provided in the specifications.

5.1 Onboard ITS Device (SCU & BDC)

Table 5-1: Hardware requirement of Onboard ITS device (SCU & BDC)

No.	Onboard ITS Device (SCU & BDC)
1	<p>(1) Single Control Unit</p> <ul style="list-style-type: none"> ■ Processor: 32/ 64 bit ■ Operating system: embedded Windows/Linux with programming software (Windows 7 or latest at the time of calling the tenders) ■ Memory: flash: 2 GB minimum, RAM 512 MB minimum (RAM memory includes SCU and BDC) ■ Interface: CAN 2.0, RS 485, RS 232, fast Ethernet, USB, digital outputs, digital/Analog inputs, WLAN, audio input output, amplified audio output ■ Interface protocols: as specified elsewhere in this document ■ In built GPS and 3G(GSM) modules ■ WLAN ■ Combi antenna using RG174 cable. The connectors on Combi antenna will be preferably SMA(M) ST plug type for GPS and FME(F) jack type 1/4"-36UNS-2B for 3G ■ In built /external two channel amplifier minimum 10 Watts rms each suitable for 4 ~8 Ohm impedance with input for external microphone ■ In-built MP3 files storage/playback function. ■ Power to SCU & BDC will be supplied through bus multiplexing wiring system <p>(2) Technical specifications: GPS modules</p> <ul style="list-style-type: none"> ■ Rating:22 tracking/66 acquisition minimum ■ Tracking sensitivity: -165 dBm typ ■ Navigation sensitivity; -148 dBm typ ■ Update rate 1 Hz (configurable to 10 Hz) ■ Time to first fix cold acquisition 35 seconds typ ■ Hot acquisition 1 second typ.

No.	Onboard ITS Device (SCU & BDC)
	<ul style="list-style-type: none"> ■ Navigation accuracy 3M horizontal <p>(3) Technical specifications: 3G(GSM) modules</p> <ul style="list-style-type: none"> ■ GSM/GPRS SMT quad band and UMTS (3G) ■ Temperature range -40°C to +85°C <p>(4) Technical specifications: ‘Combi’ Antenna</p> <ul style="list-style-type: none"> a. AMPS 850MHz, GSM900MHz, ISM868MHz, DCS1800MHz, PCS1900MHz, 3G UMTS 2.1GHz, Wifi /Blue Tooth (2.4 GHz), GPS (1575.42MHz). Separate WLAN antenna may be provided if necessary. b. GPRS <ul style="list-style-type: none"> i Impedance 50 Ohm ii Radiation pattern Omni-directional iii Polarization linear (vertical) c. GPS <ul style="list-style-type: none"> i Impedance 50 Ohms ii VSWR <1.5:1 iii Polarization RHCP d. Waterproof IP-66 e. Temperature range -40°C to +85°C
2	<p>Technical Specification: BDC</p> <ul style="list-style-type: none"> a. Display <ul style="list-style-type: none"> i Size 8” diagonal minimum ii Full color graphic TFT-640 x 480 dots minimum, capable of showing minimum 10 lines in English. iii Viewing angle (horizontal) 60°/75° (right/left)/ (vertical) 60°/75° (up and down)

5.2 Workstation for CAD/AVL at Depot

Table 5-2: Hardware requirement of Workstation for CAD/AVL at depot

No	Parameter	Requirements
1.	CPU	Quad core CPU with 8 threads or equivalent or better
2.	Memory	8 GB DDR4 or better
3.	Hard-Disk Drive	512 GB SSD or better
4.	Display	One number 21”-inch LCD / LED Display
5.	Display ports	4 Display Port / mini Display Ports Toolkit/Stand to install the dual monitors
6.	GPU	Base clock: 1290 Mhz or better Number of cores: 768 or better VRAM: 4GB or better Display connectors: DP 1.4, HDMI 2.0b, dual link-DVI multi- monitor support Max resolution: 7680 x 4320 @ 60 Hz or better
7.	Keyboard	Wired keyboard with 104 keys
8.	Mouse	Wired Optical with USB interface
9.	Ports	USB Ports including 2 USB 3.0 Ports and audio ports for microphone and headphone
10.	Cabinet	Mini Tower.
11.	Operating system	Windows 10 64-bit operating system
12.	Software Tools	Microsoft Office 365 or equivalent
13.	Antivirus	To be provided

5.3 UPS

Table 5-3: Hardware Requirement of UPS

No.	Item	Requirements
1.	Input voltage	■ Commercial Power generally but with existing condition of power failure, instantaneous power failure and voltage fluctuation
2	UPS	<ul style="list-style-type: none">■ three (3) hours or longer backup power supply for Workstation for CAD/AVL at Depot■ Ability to shutdown equipment safely when low battery.■ Ability to start up equipment safely when restoration of AC power.■ Protection for voltage fluctuation and voltage spike.■ Output: AC 230 V / 50 Hz sine wave, constant voltage and constant frequency.■ Long life battery to meet the Design Life.■ Output condition shall meet equipment to be supplied by the Contractor.■ Applying appropriate measures in order to be available even in severe environmental conditions outdoors.

6 Communication Requirement

Table 6-1: Communication Requirements of CAD/AVL

No.	Requirements
1.	<ul style="list-style-type: none">■ Communication between the CAD/AVL server in the CBS CCC and the on-board unit shall be Wireless 3G/4G or upcoming 5G Connectivity provided by a single communication company.■ The required bandwidth to ensure the stable communication connectivity shall be proposed by the Contractor and subsequently approved by the Engineer.

7 Installation Requirement

The proposed onboard device consists of two connected units one is computing device, and another is its driver display console peripheral. Computing device will be installed with less access to commuters/public, in a location where it will have access to vehicle power/ground and be accessible to remove for maintenance/replacement.

Driver display console will be installed on the dashboard of the bus within comfortable reach and view for the range of driver sizes, and without vibration or obstructing the driver view. During Operation & Maintenance stage contractor require to uninstall and reinstall the onboard device as required by MTC.

All required cables, connectors and accessories to be provided by the Contractor.

The Contractor shall make the provision for necessary earthing, cable, communication, quality, safety to meet the functional requirement intended for the system.

Chapter 3-3 Requirements of Passenger Information System

1 General

- (a) The Passenger Information System (PIS) will use the route and schedule adherence tracking information to provide information about predicted arrival times on PIS at terminals and bus shelters visible to waiting riders. And providing this real-time information through a website and mobile application.

2 System Configuration

The system configuration of PIS is shown in the figure below.

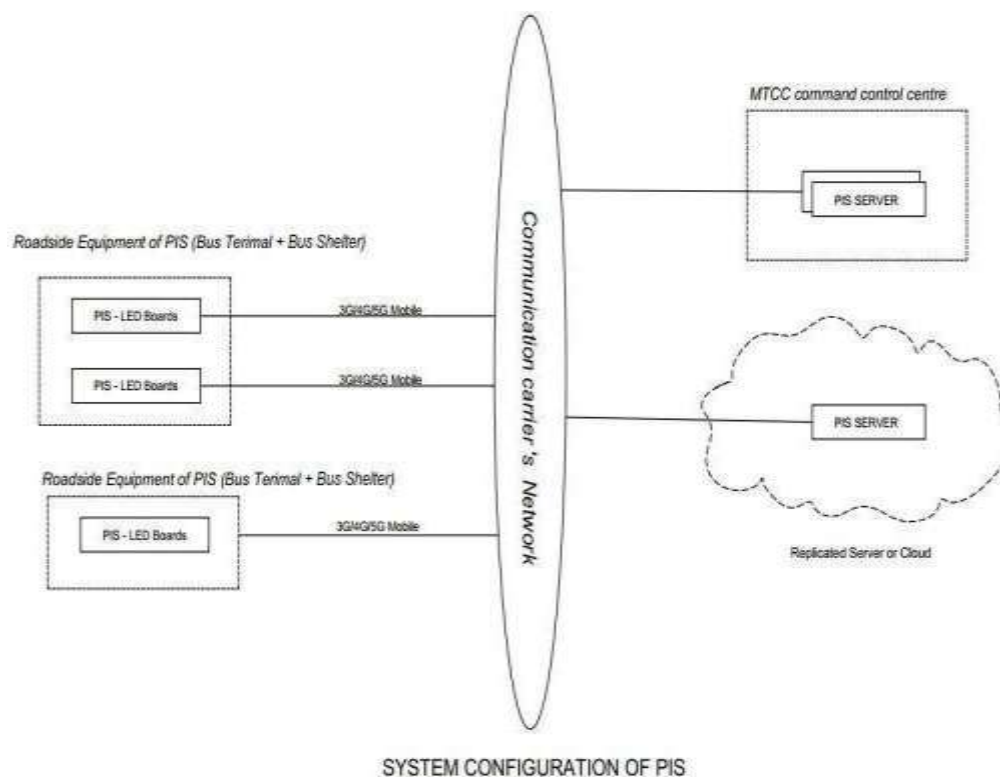


Figure 2-1: System Configuration of PIS

3 Equipment Location

The proposed locations for PIS are shown below in the Table. The Contractor shall adhere to the proposed locations as much as possible to satisfy the above requirement. In case of any changes in the locations the Contractor shall get the written approval from the Engineer based on the alignment, geometry, viewing area (based on site visit). Following are the tentative terminal and bus shelter locations.

Table 3-1: Tentative terminal and Bus Stop/Shelter locations

S. No	Bus Terminal Name	No. of Boards
1	Adyar	1
2	Adambakkam	1
3	Ambathur Estate	1
4	Anna Nagar West	2
5	Avadi	1
6	Ayanavaram	1
7	Basant Nagar	1
8	Ennore	1
9	Foreshore Estate	1
10	Iyyappanthangal	2
11	Vallalar Nagar	3
12	J.J.Nagar East	1
13	J.J.Nagar West	1
14	K.K.Nagar	1
15	K.Kannadasan Nagar	1
16	Kannagi Nagar	1
17	M.K.B.Nagar	1
18	M.M.D.A.	1
19	Mandaveli	1
20	Perambur	2
21	Periyar Nagar	1
22	Semmenchery	1
23	T.Nagar	1
24	T.V.K Nagar	1
25	Thiruvanmiyur	1
26	Thiruverkadu	2
27	Thiruvotriyur	1
28	Tollgate	1
29	Vadapalani	1
30	Villivakkam	2
31	Padiyanallur	1
32	Ambathur O.T.	1
33	Anna Square	1
34	Broadway	2
35	C.M.B.T.	2
36	Central	1

37	Chengalpet	1
38	Egmore	1
39	Guduvanchery	2
40	Guindy	2
41	Hasthinapuram	1
42	I.C.F.	1
43	I.O.C.	1
44	Karanodai	1
45	Kelambakkam	1
46	Kilkattalai	1
47	Korattur	1
48	Korukkupet	1
49	Kovalam	1
50	Kundrathur	2
51	Manali	1
52	Madhavaram Village	1
53	Mamallapuram	1
54	Medavakkam	1
55	Minjur	1
56	Pallavaram	1
57	Pattabiram	1
58	Periyapalayam	1
59	Poonamallee	1
60	Pozhichalur	1
61	Pudur	1
62	Red Hills	1
63	Saidapet	1
64	Sanatorium	1
65	Sriperumbudur	1
66	Tambaram	1
67	Thiruporur	2
68	Thiruvallur	1
69	Vandalur Zoo	1
70	Velachery	1
71	Vevekananda House	1
	Total	84

Bus Stop/Shelter Location Names:

S. No	Bus Shelter Name	No. of Boards
1	Broadway	2
2	Parrys corner	2
3	Secretariat	2
4	War memorial	2

5	Marina Beach	2
6	Kannagi Statue or presidency college	2
7	Swami Vivekananda House	2
8	Queen Marys College	2
9	All India Radio Light House	2
10	Simson or Periyar Bridge	2
11	Shanthi Theatre	2
12	LIC	2
13	Spensor Plaza TVS	2
14	Anand Theatre	2
15	Thousand light	2
16	DMS	2
17	Vanavil	2
18	SIET	2
19	Nandanam	2
20	SHB	2
21	Saidapet	2
22	Saidapet bridge	2
23	Little Mount	2
24	Concorde	2
25	Chellammal College	2
26	MGR Medical University	2
27	Guindy Railway station	2
28	Maduvankarai	2
29	Guindy MKN Salai	2
30	Prnaipalai	2
31	St. Thomas Mount	2
32	Alandur Court	2
33	Alandur	2
34	Meeanambakkam Airport	2
35	Thirusoolam	2
36	HP Petrol Station	1
37	Central Station	2
38	Hotel Everest	2
39	Thinathanthi	2
40	Dasaprakash	2
41	Sangam Theatre	2
42	KMC Hospital	2
43	Taylors Road	2
44	Pachaiyappas College	2
45	Amaindhakarai	2
46	NSK Nagar Arumbakkam	2

47	DG Vaishnava College	2
48	Arumbakkam Post Office	2
49	Arumbakkam PH Road	2
50	CIPET	2
51	Ekkattuthangal or Ambal Nagar	2
52	Kalaimagal Nagar	2
53	KK Nagar Telephone Exchange	2
54	Udhyam theater or Ashok Pillar	2
55	Vadapalani	2
56	Vadapalani Kovil	2
57	Thirunagar	2
58	MMDA Colony Road Junction	2
59	CMBT Bus Depot	2
60	Koyambedu Chathiram	2
61	Thirumangalam	2
62	Anna Nagar West Depot	2
63	wheels India Road Junction	2
64	Agrakaram	2
65	Senthil Nagar	2
66	Ambedkar Nagar	2
67	Retteri Junction	2
68	RTO or kolathur Shathri Nagar	2
69	Madhavam Roundtana	2
70	Kalpana Lamps	2
71	Kanagachathiram	2
72	Madhavaram Bus Depot	2
73	Moolakadai	2
74	Moolakadai Market	2
75	Leather Company	2
76	Santhome Church	1
77	Employment Office	2
78	Foreshore Estate	4
79	Rogini garden	1
80	MRC Nagar	2
81	Iyappan Koil	1
82	Tholkappiar Poonga	1
83	Music College	1
84	Sathya Studio	4
85	Malar hospital	3

86	Adyar Signal	1
87	Adyar Old Depot	1
88	Gandhi Nagar	4
89	Mathiyakailash	5
90	Mathiyakailash Temple	1
91	CLRI	2
92	Gandhi Mandapam	3
93	Anna University	3
94	Raj Bhavan	2
95	SPIC	2
96	Racecourse	1
97	Guindy	2
98	US Consulate	1
99	Drive in Woodlands	1
100	Semmozhi Poonga	2
101	Stella Marris	4
102	Chola Hotel	4
103	New Woodlands	4
104	AVM Rajeshwari Kalyana Mandapam	3
105	Yellow Pages	2
106	VM Street	1
107	City Centre	2
108	Kalyani Hospital	3
109	DGP Office	2
110	Nandanam	2
111	Kotturpuram	4
112	Kotturpuram Housing Board	1
113	AMM School	4
114	AC Tech	1
115	Gandhi Mandapam	1
116	Adyar Depot	3
117	Jayanthi Theatre	1
118	Tiruvanmiyur Signal	1
119	VHS Bus Stop	6
120	WPT Bus stop	6
121	Eldams Road	2
122	Eldams Road	1
123	Gemini Sun Plaza	1
124	Bharathiraja Hospital	1
125	Vani Mahal	2
126	Giri Road	1
127	Jeeva Park	1

128	Panagal Park	4
129	Thiyagaraya Nagar	1
130	Kalyan Jewellery	1
131	Globus	2
132	Holy Angels	2
133	Big Bazaar	1
134	Pondy Bazaar	1
135	Pondy Bazaar Big Bazaar	1
136	Pondy Bazaar Police Station	1
137	Pondy Bazaar Panagal Park	1
138	Venkat Narayana Road	3
139	CIT Nagar	2
140	Thiyagaraya Nagar	1
141	Viveks & Co	1
142	Bharathi Nagar	2
143	Mahalingapuram	2
144	Power House	1
145	Pudhur High School	2
146	Pudhur A School	2
147	Andhra Bank	1
148	Ashok nagar 7th Avenue	2
149	West Mambalam	1
150	Duraiswamy Subway	1
151	Burkit Road	1
152	T.Nagar Thiyagaraya Road	1
153	Nair Road	4
154	Tirumalai Pillai Road	1
155	Quality Sabari Inn Hotel	2
156	Valluvar Kottam	4
157	Nungambakkam Police Station	1
158	Sterling Road	1
159	Raj Bhavan hotel	1
160	Chetpet	1
161	Chetpet Nicholas Road	1
162	Puspha Nagar	1
163	Loyala College	4
164	Mehta Nagar	3
165	MGM Hospital	1
166	Chetpet	3
167	RTO Office	2
168	Presidency School	2
169	Egmore Childrens Hospital	2

170	Guild of Service	1
171	TB Hospital	1
172	Chetpet Taluk Office	1
173	Meterological Department	3
174	Standard Charted	1
175	Shastri Bhavan	3
176	Sterling Road	2
177	Uttamar Gandhi Salai	1
178	Taj Coramandel	2
179	Taj Coramandel	2
180	Income Tax Office	1
181	Isphani Centre	2
182	MOP Vaishnava	1
183	Wellington Plaza	2
184	Express Avenue	1
185	Royapettah Woodlands Theatre	1
186	Wesley School	3
187	Royapettah Hospital	1
188	Hotel Swagath	1
189	Ajantha Hotel	2
190	Tiruvalluvar Statue	3
191	Luz Corner	1
192	Mylapore Tank	5
193	RK Mutt Road	1
194	Mandaveli Market	1
195	Mandaveli BSNL Office	2
196	Rani Meiyammai	1
197	RK Mutt Road	1
198	CID Quarters	4
199	Devanathan Street Bus Stop	1
200	Sirungeri Mutt Stop	1
201	Kaliyappa Hospital	1
202	Crown Plaza	1
203	Park Sheraton	1
204	Chamiers Road	2
205	Venkateswara Hospital	1
206	Adyar Gate	3
207	Indian Terrain	1
208	TTK Road	1
209	Ethiraj Kalyana Mandapam	2
210	Alwarpet	1
211	Narathagana Saba	2

212	Ramada Raj Park	2
213	Music Academy	2
214	Gaudia Mutt Road	1
215	Avvai Shanmugam Salai	1
216	Khadi Gramodhaya Bhavan	1
217	Avvai Shanmugam Salai	1
218	Gopalapuram ground	2
219	Peters Road	1
220	Church Park	1
221	Monagan School	1
222	New College	1
223	Meersahib Market	1
224	ICE House	2
225	NKT School	1
226	V.House	1
227	Presidency College(Kannagi Selai)	2
228	Rathna Cafe	1
229	KasturiBhai Hospital Bells Road	2
230	Bells Road	2
231	Ezhilagam & Chepauk	1
232	Kalaivanar Arangam	1
233	Walajah Road	1
234	Triplicane Police Station	2
235	Big Street	1
236	Triplicane	1
237	Triplicane registration Office	1
238	Adama Market Road	2
239	Triplicane Post Office	1
240	Kelet High Road	1
241	Santhome Church	2
242	Katcheri Road	2
243	Kamadenu	2
244	Luz Corner	1
245	Anjaneyar Road	2
246	Vivekananda College	1
247	Isabella Hospital	1
248	Avvai Home School	1
249	Besant Nagar	1
250	Alcot School	1
251	Besant Nagar Depot	1
252	Besant Nagar	2
253	RBI Quarters	1

254	Vannathurai	2
255	Indira Nagar Water Tank	3
256	Aranganathan Subway	1
257	Srinivasa Theatre	1
258	Mettupalayam	1
259	Mettupalayam	1
260	RR Colony	2
261	Raghava Colony	1
262	West Saidapet	1
263	Jayaraj Theatre	1
264	Manthoppu School	2
265	Jones Road	1
266	TNHB Flats	1
267	Kamdar Nagar	1
268	Periyar Road	3
269	Vetinary Hospital	1
270	Opp to ONYX	2
271	MGR Salai	1
272	Palm Grove	1
273	Vidyodaya school	2
274	Meenakshi College	3
275	Meenakshi College	1
276	Trustpuram School	2
277	Powerhouse	3
278	Ram theater	3
279	Pachaiyappa College	1
280	New Avadi Road	1
281	Kilpauk Garden	1
282	Water Tank Kilpauk New Avadi Rd	1
283	VOC Nagar	1
284	Gandhi Nagar Hospital	2
285	Gandhi Nagar	1
286	Nathamuni Talkies	1
287	Bala Vihar	2
288	Chinthamani	2
289	Anna Nagar Roundtana	2
290	Blue Star	2
291	Ayyapan Kovil	2
292	12th Main Road	2
293	Aminjikarai Police Station	1
294	Anna Siddha Hospital	2
295	Vasantham Colony	1

296	Labour Officers Quarters	2
297	Vijaya Maruthi (Anna Nagar)	1
298	South Colony	2
	Total	532

4 System Functional Requirement

Table 4-1: Functional requirement of PIS

SI No.	Requirements
Real-Time PIS Display Boards	
1.	PIS shall be used to display information to passengers at selected bus terminals and busstops.
2.	The signs shall support a variety of information display schemes, including multi-phase messages and the ability to display scrolling text. Related parameters (e.g. Multi-phase Message Transition Time, Display Line Scroll Speed and List Sorted By) shall be configurable.
3.	Content can include –Transportation Information (Bus schedules, alerts, etc.), safety information, localized community information, GPS driven localized data, Environmental data, advertising (still images, animation, video), tourist information.
4.	All type of PIS shall have the capacity to store static information in the display controller (including schedules), which shall be shown if the communication link is lost and after real-time information expires.
5.	The static information shall be stored in non-volatile memory, with memory capacity at least double that required for the initial data.
6.	The total weight of the signs, including all internal and external components, shall be such that it doesn't cause any structural or any other damage to the structure to which the sign is mounted. Contractors need to assess the existing structure and design the PIS mounting provision.
7.	The sign enclosures shall be vandal proof, and the housing shall be black for effective message contrast and legibility.
8.	The sign assemblies shall be secured to sustain the shock and vibration that exists in outdoor environment.
9.	The signs shall not contain controls accessible to the public.
10.	The signs shall be legible when sunlight is shining directly on the display face or when the sun is directly behind the display.
11.	PIS software that can upload Tamil and English text as per business and operational needs of the Employer shall be provided.
12.	The PIS display board shall be industrial grade that can withstand the environmental and working conditions found at bus bus/shelter and terminals in Chennai. The panels shall allow for 24/7 operations.
13.	The signs shall be capable of receiving the following as inputs from the central system, on an as-required basis: <ul style="list-style-type: none"> • System management commands (e.g. system status requests) • Static display information (e.g. bus schedules, hours of operation and bus routes) • Real-time display information (e.g. current time and time until arrival of next bus(es)) • Ad-hoc information (e.g. traveller warnings, current weather conditions and advertisements) PIS shall support alphanumeric, video, image, animations and graphics.
14.	All types of display board shall provide for modular layout enabling parallel display of content on different areas of the screen – Transit information, Time/Date, Weather, Public announcements, Commercial advertising.
15.	All types of display boards shall have in-built test facility, able to carry out self-check at periodic intervals as well as exchange of diagnostic information from the central control stations including power availability, and its current status.
16.	The display system shall support remote settings such as display intensity, time synchronization.
17.	PIS display shall be refreshed automatically every 10 seconds to show updated information.

18	When an entire message cannot fit on the PIS, it shall be possible to display the entire message by displaying the message using multiple frames by pagination or scrolling through the messages.
19	The choice of display method will be selectable by the Employer and message scroll speed shall be fully configurable by the Employer.
20	Time for which information is displayed in each language shall be configurable by the Employer.
21	PIS application shall be integrated with Environmental sensor application and display the environmental information on PIS display board.
22	PIS displays shall be managed locally without workstation or server.
23	Contractor shall arrange all the switches, network items and cables, etc. as required.
24	Contractor shall be responsible for arrangement of all communication.
25	The API and Integration document to be provided for to integrate with PIS application and any other application envisaged by MTC.
26	Display boards shall have NTCIP communication protocol. No proprietary protocol is allowed to use.
27	Characters shall be at least 8cm - 12 cm high to allow for a viewing distance up to 15 meters at bus stops/shelters for Type B and Type C LED boards and up to 30 meters viewing distance for the Type A LED display boards.
28	For Type A display boards 3 hours power backup and for Type B and C display boards 1 hour power backup is required.
29	Only outdoor rated UTP CAT6 cable shall be used to connect the device to the respective switch port. If for any case, the distance between the switch port and device exceeds 90 m, use outdoor rated multi-mode fibre cable with environmentally rugged media converters.
30	The system shall default to display the predicted number of minutes until arrival of the next bus.
Website Requirement	
31	Website shall be designed to show the information in Tamil and English language.
32	Website shall allow commuter to plan their bus trip using direct routes and transfers of the city-wide bus system including suburban buses.
33	Information requested by commuter on map line diagram or table shall be updated automatically without manual page refresh.
34	The Contractor shall build the new website pages with the purchaser input (branding, graphics and colours).
35	The Contractor shall be responsible for integration and setup of the website and source code of the website shall be submitted by the Contractor.
36	The Bidder shall provide a Web Server to host the website.
SMS	
37	Contractor is expected to develop SMS for commuters without a GPRS connection with their mobile. This is to provide ETA, Stop code, fare, pass, route no, etc., through SMS.
38	All the sent and receive SMS information shall be stored in the system to generate report by dispatcher. At least 10,000 SMS shall be considered every month.
39	Contractor requested to provide complete support if any third-party integration id required to integrate SMS for MTC
40	Contractor to develop the SMS system to provide both instant response and preconfigured.
41	Contractor to provide the report with the detail of how many SMS sent from system, how many are received, unique numbers, etc.
42	Contractor has to develop the Mobile application that shall work in at least two major mobile OS platforms. Preferably Android, and iOS platform
43	Contractor is responsible to upload the software to online mobile stores on behalf of MTC
Mobile Application	
44	<p>The mobile application/website shall have at least following features both in Tamil and English :</p> <ul style="list-style-type: none"> • Smart card recharge • Vehicle location finder • Real time bus arrival on the selected bus station • Commuter to find the nearest bus station from his/her location along with distance • Display ETA for the selected bus station, buses arrive in next 15 minutes • Find nearest landmark (this will be shared by purchaser)

	<ul style="list-style-type: none">• Provide Fare, Stop name, Stop code, Bus Pass, other major places, feedback,• Provide option for commuter to share the photos taken in case of any problem they found on the bus service limited to project jurisdiction (Chennai)• Feedback/ Grievances• Distance between two stops• Displays stop code and name for the selected route/direction• Notification on the predefined alerts• Identify nearest parking location• Integration with other mode of transport• Source code of the Mobile application shall be submitted by the Contractor.
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5 Hardware Requirement

All hardware equipment shall as a minimum, meet all the requirements listed in the specifications. The equipment's provided shall accommodate to future technological advances which exceeds the minimum requirements provided in the specifications.

5.1 LED display board

Table 5-1: Hardware requirement of LED display board

S. No.	Parameter	Requirements
1.	Color	Amber
2.	Brightness & Legibility	To be read even in broad daylight without any shade. The displayed image shall not appear to flicker to the normal human eye.
3.	Luminance Class	L-3 as per EN 12966
4.	Display capability	Fully programmable, LED displays, Alpha-numeric, Pictorials, Information on the display shall be refreshed every 10 seconds
5.	Information Display Method	Static, Dynamic, Pagination, Right - Left,
6.	Display Language	Multilingual Tamil and English
7.	Display Front Panel	100% anti-glare
8.	Auto Dimming	Auto dimming sensor adjusts to ambient light level
9.	Display Area	For Type A, clear viewing area Horizontal: 3.00 meters Vertical: 2.50 meters For Type B, clear viewing area Horizontal: 1.20 meters Vertical: 1.00 meters For Type C, clear viewing area Horizontal: 1.20 meters Vertical: 0.60 meters Clear viewing area means excluding frame, brackets, etc.
10.	Number of Lines in each type of board	For Type A – 10 lines For Type B – 4 lines For Type C – 2 lines
11.	Connectivity	Ethernet or GPRS through modem for each display board separately
12.	Protocol	NTCIP protocol
13.	Controller	Controller shall have the functionality to turn off the display when not required or non-operational hours.
14.	Casing	Front: IP-54 for Display of PIS Rear and Side: IP-66 for cabinet
15.	Operating conditions	0° to 55°C
16.	Pole and Foundation	The pole and handing provision shall withstand at least 180 km wind speed for all type of display boards
17.	Earthing and Lighting Arrester	Earthing and Lighting arrester to be designed and provided

5.2 Power Supply and Outdoor UPS

Table 5-2: Hardware Requirement of Outdoor UPS

No.	Item	Requirements
1.	Input / Output Voltage	<ul style="list-style-type: none">■ AC 230 V / 50 Hz basically.■ Output voltage: AC230V/50Hz■ Commercial Power generally but with existing condition of power failure, instantaneous power failure and voltage fluctuation
2	UPS	<ul style="list-style-type: none">■ The UPS shall be of True online with double conversion topology.■ The UPS shall work in outdoor environment to ensure all equipment's getting necessary power supply. No power surge.■ The UPS unit shall have load level indicators that display the approximate electrical load placed upon the UPS. The UPS unit shall have a row of battery level indicators that display the approximate battery capacity.■ The UPS unit shall have a minimum of the following as per OEM standard indicators:<ul style="list-style-type: none">➢ UPS Mode: On-line, Backup/Battery and Bypass;➢ Over Load Indicator: This will display when UPS is running on overload;➢ Battery Status Indicator: This will illuminate when battery is low or faulty/disconnected; and➢ System Fault: This will illuminate when there is some fault or interruption in UPS.■ The UPS unit shall include Ethernet communication port to support remote management and monitoring capabilities using SNMP including alarm contacts and remote shutdown. Remote monitoring and testing software shall be included. The manufacturer shall provide all SNMP traps.■ The UPS unit shall include automatic restart. Upon restoration of utility AC power after complete battery discharge, the UPS shall automatically restart and resume operation.■ The UPS unit shall be compliant to IEC 62040-1, CE, IEC602040-2 safety standards.■ The UPS and batteries shall be mounted in a separate cabinet & the enclosure shall be under lock & key, utilising the minimum possible space and arranged in an aesthetic manner.■ Any field UPS system (as per MSI's design) shall be supplied with an environmentally rated cabinet for installation of the UPS and batteries. The cabinet shall have a rating of IP 55. The cabinet shall be supplied with in-built fans and proper ventilation as needed to ensure that the temperature inside the cabinet does not exceed 40 degrees C at any given point in time.■ Backup time at least 3 hrs for Type A and 1 hour for Type B & C

5.3 Pole

Table 5-3: Pole Specification

No.	Item Specification
1.	<ul style="list-style-type: none">■ The PIS shall be installed either on T shape structure.■ The Contractor shall make all design considerations during design of pole to withstand

	<p>wind speeds of at least 180 kmph and shall be designed and approved by the Engineer and following appropriate guidelines.</p> <ul style="list-style-type: none"> ■ Any cable entering into the PIS board shall be properly protected and should not be visible outside. ■ PIS Pole shall be hot dip galvanized after fabrication with silver coating of 86 micron as per IS:2629; Fabrication in accordance with IS-2713 (1980) ■ Height of pole shall be minimum 3 meters above the ground. ■ Casting of Civil Foundation with foundation bolts, to ensure vibration free erection ■ The pole shall be equipped with lightning arrester as per the requirements ■ The Structure should have walkway for maintenance staff to easily access and maintain PIS. ■ The passage from structure to PIS should have locking provisions to avoid any unauthorized access. ■ A sign board describing words such as “Don’t Touch / This area is under surveillance” shall be hanged on the pole. The Contractor shall conduct the detailed design for the pole based on his site survey. ■ The Contractor shall conduct the appropriate measure for preventing the vibration which will affect the detection accuracy. ■ All components of poles may be hot dip galvanized, all components must be well protected against corrosion, minimum thickness of zinc coatings is 85 μ m and min density 500 gm/m² on both inside and outside surfaces ■ Certified BS EN 10025-4:2019 – TC ■ Required Lighting arrester arrangement inside the pole.
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6 Communication Requirement

Table 6-1: Communication Requirements of PIS

No.	Requirements
1.	<ul style="list-style-type: none"> ■ Communication between the PIS server in the CCC and the PIS board at each terminal shall be Wireless Connectivity provided by a single communication company. ■ The required bandwidth to ensure the stable communication connectivity shall be proposed by the Contractor and subsequently approved by the Engineer.

7 Installation Requirement

The Contractor shall make the provision for necessary civil, foundation, earthing, necessary cable conducting, manhole, Power supply, redundant communication, new meter connection, quality, safety and last mile connectivity etc. to meet the functional requirement intended for the system.

The Contractor shall obtain necessary permission from respective agency.

At the terminals and bus shelters, LED based passenger information display boards will be installed with their base at least 10 feet height from the surface level. LED board will be installed on the unipole structure with strong foundation, and with orientation configured with MTC for desired areas where riders will need to view. Pole will be MS material with rust protection coating, and with safety warning stickers as per standard. UPS to be fixed on the cabinet to protect from vandalism.

Chapter 3-4 Requirements of Depot Management System

1 General

- (a) Each depot will be equipped with the Depot Management System (DMS) to enable and manage their effective operation. This software will manage service scheduling, crew rostering, asset management and maintenance, vehicle fueling/availability, crew attendance, and business intelligence/reporting.

2 System Configuration

The system configuration of DMS is shown in the figure below.

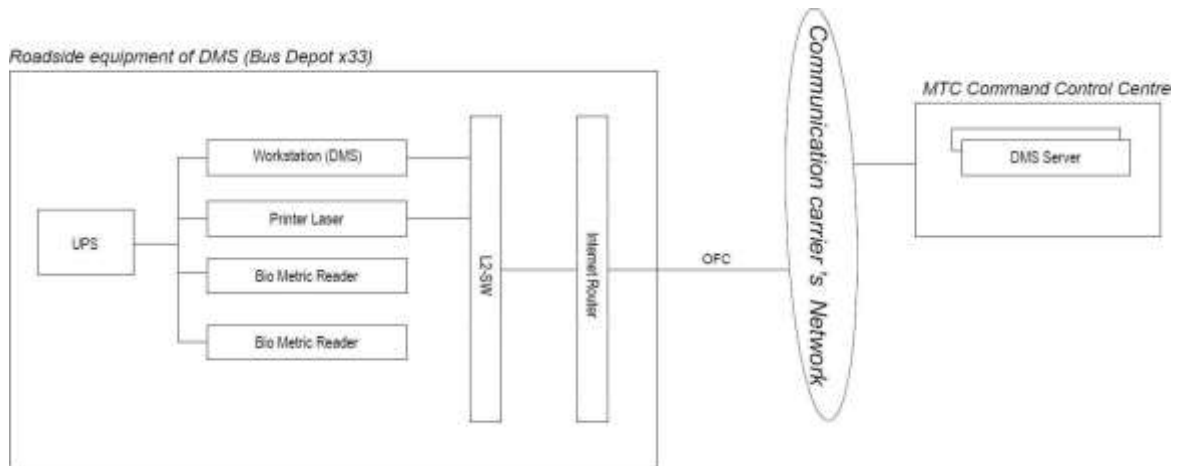


Figure 2-1: System Configuration of DMS

3 Equipment Location

The proposed locations for DMS are shown below in the Table. The Contractor shall adhere to the proposed locations as much as possible to satisfy the above requirement. In case of any changes in the locations the Contractor shall get the written approval from the Engineer based on the alignment, geometry, viewing area (based on site visit).

Table 3-1: Depot locations

No.	Location Type	Location Name	Latitude	Longitude
1	Depot	Adambakkam	12.99489	80.20669
2	Depot	Adyar	12.998189	80.256461
3	Depot	Alandur	12.997006	80.191718
4	Depot	Ambattur Industrial Estate	13.099555	80.169956
5	Depot	Anna Nagar West	13.093802	80.198147
6	Depot	Avadi	13.12138	80.102082
7	Depot	Ayanavaram	13.098746	80.241035
8	Depot	Ayyapanthangal	13.037233	80.134635

9	Depot	Basin Bridge	13.102701	80.273682
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No.	Location Type	Location Name	Latitude	Longitude
10	Depot	Central Depot	13.07584	80.275799
11	Depot	Chrompet I	12.947442	80.14092
12	Depot	Chrompet II	12.947509	80.144356
13	Depot	Ennore	13.215657	80.32077
14	Depot	K.K Nagar	13.034841	80.205415
15	Depot	Kundrathur	12.980404	80.102187
16	Depot	Madhavaram	13.131771	80.236474
17	Depot	Mandaveli	13.026362	80.266311
18	Depot	Padiyanallur	13.203698	80.174104
19	Depot	Perambur	13.102234	80.249026
20	Depot	Poonamallee	13.052055	80.090679
21	Depot	Saidapet	13.014439	80.225685
22	Depot	Tambaram	12.932504	80.121025
23	Depot	Theyagaraya Nagar	13.034499	80.230046
24	Depot	Thiruvannmiyur	12.986873	80.259291
25	Depot	Thiruvottiyur	13.172324	80.304347
26	Depot	Tondairpet I	13.131906	80.292436
27	Depot	Tondairpet II with Workshop	13.135094	80.290183
28	Depot	Vadapalani	13.05047	80.206876
29	Depot	Vyasarpadi	13.120182	80.259245
30	Depot	Kannagi Nagar	12.925528	80.238407
31	Depot	Perumbakkam	12.886605	80.210028

4 System Functional Requirement

Table 4-1: Functional requirement of Depot Management System

No	General Requirements
1.	The system shall be able to support operations for a minimum of 6000 buses.
2.	Ability to optimize the complete service delivery by developing the route and publish final timetables & rosters.
3.	Ability to Generate informative statistical summaries and MIS from the system
4.	<p>The software shall provide standard reports based on the DMS data. Bidders shall provide details in their proposal related to reports offered and the degree to which they can be configured (at minimum all reports shall be configurable for a specified date/time range and routes or schedules or service type). Summary reports for different levels of management staff shall be designed by Contractor during the design stage. Automated graphs/plots for commonly used data shall be provided in discussion with the Employer. Following are tentative list, this may be updated/added during design and implementation period:</p> <ul style="list-style-type: none"> •Route Plan & Timetables • Trips & Vehicle Planning • Crew Schedules

	<ul style="list-style-type: none"> • Roster and Dispatch (Operations) • Crew Kiosks (optional) • Performance monitoring • Bus travel time data from CAD/AVL system
5.	The application shall provide feature for creating vehicles in one depot and process for transferring vehicles to other depots.
6.	Application shall have feature to capture trip/schedule wise revenue kilometre
7.	Capability to capture dead kilometres in the System.
8.	Ability to define and create Charter trips into the system. Solution shall provide the entire process – Quote, Booking, Allocation, Invoicing, etc
9.	The charter trips should be reflected into the operation module for rostering and dispatch functions.
10.	Ability to capture requirements from customer for chartered trips into the system.
11.	Ability to make quick changes in routes and bus stop locations due to traffic management (traffic police) changes (one-way streets, construction, etc.)
12.	Ability to create users in the system
13.	Ability to assign roles, access and user permission in the system
14.	System should support user defined event definition for sending alerts and message
15.	System should be able to send alerts and email based on certain conditions/events/transactions.
16.	Ability to produce printouts of crew schedules, duty rosters, route timetables, bus stop timetables etc.
17.	Ability to generate On-demand statistical reports and summaries
18.	<p>The system shall ability to generate following reports, but not limited to,</p> <ul style="list-style-type: none"> • Route • Timetable • Crew Rostering • Statistics Report - Headway, Running times for each trips. • Dispatch report • Schedule cancellation report • Crew allocation • Schedule allocation • Crew utilization report • Fleet departure at depot • Fleet dead KM per route/ fleet wise • Revenue kilometre • Schedule or trip cancellation • Crew license renewal history • Overtime details per staff wise
19.	The ability to import and export master data such as nodes detail with its respective GIS data to the Map, Crew, Vehicle, Schedule, Routes with stop, etc.
20.	System shall provide facility to export data/reports into PDF, Excel, CSV and XML formats
21.	Proposed System should be able to perform trip time deviation analysis to find where the critical trips
22.	Route Creation and Timetable
Vehicle Scheduling & Dispatching & Crew Rostering	
23.	System should have ability to edit/specify inbound and/or outbound timetable for a specified day type.
24.	Allow user to define the path type for the timetable - circular, loop, Radial etc.
25.	Ability to add, edit and copy/duplicate timetables
26.	Only authorized user should be able add, edit or delete timetables
27.	Ability to link/add trips to the selected timetable.
28.	Allow an authorized user to add, edit, delete and copy/duplicate a bus schedule.
29.	Ability to link all the inbound and outbound trips in manual, assisted and auto mode.
30.	Ability to indicate the number of buses required to operate all of the trips upon complete linking of all the trips.

31.	System shall have ability to provide appropriate error messages in case layover times and deadrun timings do not match in the timetables, buses are less, Crew are less, etc.
32.	System shall have ability to minimize shifts
33.	System shall have ability to minimize layover time at Depots and meal/relief points
34.	System shall have ability to suggest minimum vehicles required for the schedule.
35.	System shall have ability to maximise or minimise the bus running hours
36.	System shall have ability to display exceptions such as trip without any bus
37.	System shall have ability to colour code trips
38.	System shall have ability to link /unlink buses to trips
39.	System shall have ability to perform parallel scheduling of services such as trunk and feeder system, the schedule of the trunk bus and the feeder bus must be synchronized to the extent possible, to minimize the transfer waiting time for passengers. The system should allow for such synchronization and calculate automatically the trips and schedules of a route/multiple routes
40.	System shall have ability to provide multiple MIS and reports from the System, including but not limited to: <ul style="list-style-type: none"> • For timetable • by path • by route • by start time • by end time • by trip number • by distance • by speed • bus arrival and departure summary from a depot • Number of buses operating in traffic from a depot and/or division spread over 24 hours
41.	The system shall support existing MTC employee rules. The Contractor is expected to study before the bid submission.
42.	System shall have ability to create crew schedules considering different shift parameters such as shift spreads, mealtime etc.
43.	System shall have ability to create crew scheduling as per the Motor Vehicle Act followed by MTC.
44.	System shall have ability to define shift start and end points
45.	System shall have ability to minimize travel time from relief points to depot / meal locations
46.	System shall have ability to minimize breaks between 2 blocks of service
47.	System shall have ability to schedule duties such that the last portion of duty shall close at a particular depot/terminal or specified location defined by MTC
48.	System should be capable of creating crew schedules for bus schedules that operate from a specific depot or division.
49.	Crew transfer within division
50.	Capability to create crew schedule considering a specific meal break location for a particular Route Number / selected route numbers
51.	System should be accessible by all Depot authorized users to download the Crew schedules created by the system
52.	System shall support following reports but not limited to, <ul style="list-style-type: none"> a) Detailed Crew report for each duty / crew day(s) of the week clearly indicating Sign On, Sign Off , Trip details that are to be performed, meal break location, etc.. b) Consolidated Crew report for all duties in a depot for day(s) of the week clearly indicating Sign On, Sign Off , Steering time and hours of duty for driver and conductors c) Statistics reports of crew and depot. d) Horizontal Blocks to provide duty wise details of each crew along with the Route number on which they will perform duty
53.	The Bidder shall provide a Crew Rostering Software, already used by Public Transport Operators.
54.	The Software shall have provision for creating the Roster as per Rules, Acts and statutory requirements.
55.	Crew Rostering module shall be able to create group of users based on set of defined parameters.

56.	The proposed rostering module shall plan and generate the rostering automatically for next one month, through to the end of the current financial year, or for the subsequent fiscal year.
57.	It shall allow admin or authorized user to create and view the planning for a week/month before applying it to real production.
58.	System shall have provisions to easily make changes to the planned roster
59.	System shall have provision to create rosters for user definable day types such as Public Holidays, weekends etc.
60.	System shall have capability to automatically rotate crew as per the user definable parameters
61.	System shall have ability to create groups and types of crew.
62.	System shall have ability to assign crew work/duties based on user defined groups
63.	System should have provision to include non-driving work in the roster
64.	System should have provision to utilise drivers from other Depots
65.	The proposed rostering application shall display or provide rostering using graphical representation for the selected period
66.	The Rostering module shall interface with scheduling module to assign crews automatically to the schedule.
67.	In case schedule is cancelled then rostering shall update crew's operation hours, ideal hours, etc., for day to improve the operation.
68.	Rostering shall have technique to minimize and help MTC in identifying the non-performing/underperforming crew.
69.	All schedules shall be identified by schedule number and/or start and destination name.
70.	Schedule master shall have minimum start place, end place, starting and end time of each trip, rest time in between the trips, distance between the start and end place, distance between stops, overnight stay, crew name, fleet registration number, etc.
71.	Scheduling module shall allow admin or authorized user to update, modify or cancel the schedule.
72.	It shall also allow user to cancel a particular trip in the case of a partial schedule cancellation.
73.	The proposed application shall allow users to modify/update the schedule quickly.
74.	The system shall provide following MIS reports at minimum, but are not limited to (Following are tentative list, this may be updated/added during design and implementation period): <ul style="list-style-type: none"> • Distance Reports • Depot Reports • Station Reports • Route Reports • Form-4 Reports or any other types followed in MTC • Anomalies Reports • Dead Kilometre Reports • Comparative Reports
75.	A design document for content and formats for the display board information shall be developed by the Contractor and approval shall be obtained from the Purchaser before implementing the design.
76.	Bidder shall provide one Printer cum scanner to each depot to scan A4 and letter size paper.
77.	The software shall have the capability to generate reports based on exceptions as per thresholds set by MTC.
78.	The Bidder shall provide tools to generate ad-hoc reports on stored CAD/AVL data.
79.	All reports must use standard reporting tools similar to Apache Spark, Hadoop, IBM IoT framework, Microsoft Azure, and have the ability to export data into file formats that can be exported to and edited with standard office software (e.g., Microsoft Word and Excel, Adobe Acrobat .PDF)
80.	Any portion of the transactional database shall be exportable in standard formats (such as .csv, xls, xlsx, xml, etc.) for analysis in third party programs.
81.	A data dictionary shall be provided to MTC to facilitate development of custom reports.
82.	All reports shall be generated using a query language and standard query engine (to be approved by MTC) that provides flexibility for future updates, and for creation of new reports.
83.	Reporting software shall include the ability to generate graphs and charts based on criteria and format defined by the user

84.	The Software shall be capable of establishing automatic periodic (monthly/ quarterly/ yearly) routines to automatically produce and email standard reports to defined user groups.
85.	The Software shall provide a web-based reporting tool to allow for access from anywhere. The access and views of the reports will be based on Role based access control.
86.	Software shall allow MTC to generate Summary and Detail reports as applicable.
87.	The system shall provide following reports at minimum, but are not limited to (Additional reports and Template will be discussed finalized along with MTC during the design stage) : <ul style="list-style-type: none"> • Breakdown • Accident • Vehicle In/Out • Pending Maintenance • KMPL for each Fleet • Vehicle FC, Road permit history • Complete history of each vehicle maintenance by month and year
88.	The proposed application shall store employee related master details without any limitation.
89.	Attendance shall be recorded using Biometric Readers installed at various places across MTC locations.
90.	The system shall not allow any records to be deleted. But it shall allow admin to edit employee personal info, others as required.
91.	Access shall be configurable based on location/user-type/user-group.
92.	The Super User or Admin shall have access to all data.
93.	The Master table will have minimum of Date of birth, Date of Joining, Earlier Service, Experience, Department, Designation, Seniority, Salary, etc.
94.	Attendance system shall interface with Depot Management System to provide crew absence.
95.	Overtime and festival working remuneration shall be calculated automatically by the System.
96.	System shall Maintain leave and holidays as per MTC list or as desired by the Employer time to time.
97.	Application shall have provision to request transfer of fleet/bus and crew to other depots or other places.
98.	Staff shall be able to check available vacation and sick leave using the system.
99.	Application shall support deputation for emergency and required time.
100.	System shall be able to save documents like birth certificates, education certificates, license, offer/ appointment order, etc.
101.	Admin shall be able to export birth certificates, education certificates, license, offer/ appointment order, etc. from the system in PDF format.
102.	The proposed systems shall be interfaced with ITS systems as mentioned in this RFP document.
103.	All modules/sub-modules of the Depot Management System shall be seamlessly integrated
104.	System shall support deriving efficient vehicle assignment by route through minimizing repositioning and dead runs
105.	System shall have integrated Optimization Tool for vehicle and crew based on various constraints and preferences
106.	The solution shall have ability to generate “what-if” scenarios.
107.	The mobile application shall have at least following minimum features both in Tamil and English: <ul style="list-style-type: none"> • Mobile app shall show the features as per role defined during design stage. • For crew, fleet Schedule and vehicle details, license renewal, request for leave, attendance • For branch manager, fleet FC renewal, fleet maximum operational years or maximum running kilo meter • Provide option to share the photos taken during incidents

5 Hardware Requirement

5.1 Workstation at Depot for DMS

Table 5-1: Hardware requirement of Workstation at depot for DMS

No	Item	Requirements
1.	CPU	Quad core CPU with 8 threads or equivalent or better
2.	Memory	8 GB DDR4 or better
3.	Hard-Disk Drive	512 GB SSD or better
4.	Display	One number 21"-inch LCD / LED Display
5.	Display ports	4 Display Port / mini-Display Ports Toolkit/Stand to install the dual monitors
6.	GPU	Base clock: 1290 Mhz or better Number of cores: 768 or better VRAM: 4GB or better Display connectors: DP 1.4, HDMI 2.0b, dual link-DVI multi-monitor support Max resolution: 7680 x 4320 @ 60 Hz or better
7.	Keyboard	Wired keyboard with 104 keys
8.	Mouse	Wired Optical with USB interface
9.	Ports	USB Ports including 2 USB 3.0 Ports and audio ports for microphone and headphone
10.	Cabinet	Mini Tower.
11.	Operating system	Windows 10 64-bit operating system
12.	Software Tools	Microsoft Office 365 or equivalent
13.	Antivirus	To be provided

5.2 Laser Printer – A4

Table 5-2: Hardware requirement of Laser printer – A4

No	Item	Requirements
1.	Print Speed	Black: 16 ppm or A3, 24 ppm or above on A4
2.	Resolution	600 X 600 DPI
3.	Memory	8 MB or more
4.	Paper Size	A4, Legal, Letter, Executive, custom sizes
5.	Paper Capacity	250 sheets or above on standard input tray, 100 Sheet or above on Output Tray
6.	Duty Cycle	25,000 sheets or better per month
7.	OS Support	Windows 8, and any latest version
8.	Interface	Ethernet Interface
9.	Other requirement(s)	Shall have the ability to Scan, Send and Receive Fax

5.3 Biometric Reader

Table 5-3: Hardware requirement of Biometric reader

No	Item	Requirements
1.	Display	LCD display with operating system
2.	Reader Type	Both Fingerprint and Smart card
3.	Memory	Internal: 512MB External: 2 GB
4.	Application	API / Web application
5.	Connectivity	Ethernet, Wi-Fi, USB

6.	Power supply	12v DC and inbuilt battery backup of 2 hours
7.	Security certification	STQC
8.	Storage capacity	Two fingers of each staff: 1,000 Smart card: 500 Transaction storage 1,00,000

5.4 UPS at Depot

Table 5-4: Hardware requirement of UPS at depot

No	Item	Requirements
1	Capacity	Adequate capacity to cover all above IT Components at respective location
2	Output Wave Form	Pure Sine wave
3	Input Power Factor at Full Load	>0.90
4	Input	Three Phase 3 Wire for over 100 KVA
5	Input Voltage Range	305-475VAC at Full Load
6	Input Frequency	50Hz +/- 3 Hz
7	Output Voltage	400V AC, Three Phase for over 100 KVA UPS
8	Output Frequency	50Hz+/- 0.5% (Free running); +/- 3% (Sync. Mode)
9	Inverter efficiency	>90%
10	Overall AC-AC Efficiency	>85%
11	Battery Backup	3 hours in full load with SMF battery
12	Indicators & Metering	Indicators for AC Mains, Load on Battery, Fault, Load Level, Battery Low Warning, Inverter On, UPS on Bypass, Overload, etc.
13	Cabinet	Rack / Tower type
14	Operating Temp	0°C to 50°C

6 Communication Requirement

Table 6-1: Communication Requirements of DMS

No.	Minimum Specifications
1.	<ul style="list-style-type: none"> Communication between the DMS terminal at each depot and the DMS server at CBS CCC shall be wired connectivity provided by a single communication company, if required MPLS VPN shall be provided. The required bandwidth for DMS to ensure the stable communication connectivity shall be proposed by the Contractor and subsequently approved by the Engineer.

7 Installation Requirement

The Contractor shall make the provision for necessary civil, foundation, earthing, necessary cable conducting, manhole, Power supply, redundant communication, new meter connection, quality, safety and last mile connectivity etc. to meet the functional requirement intended for the system.

The Contractor shall obtain necessary permission from respective agency.

A smart card reader (with associated camera to capture image of the person using) will be installed near each entry and exit of the depot to log attendance times within the facility. These devices will be powered by UPS backup to ensure smooth and continuous operation.

Chapter 4 Bill of Quantity (BOQ)

1 Supply of Plant/Equipment and Spare parts

Item No.	Description	Unit	Qty
(1)	(2)	(3)	(4)
201	Chennai Traffic Information & Management System Command Control Centre (TIMS-CCC)	-	-
i	Control Centre Room	-	-
A1	Call Centre Application and Database	No	1
A2	IP PABX System with IVR	No	1
A3	Operator Client Licenses	Lot	1
ii	Meeting Room	-	-
A4	70" LED display	Nos	2
A5	Over Head Projector	No	1
iii	Furniture	-	-
A6	TIMS Operation Room Operator Desks	Lot	1
A7	TIMS Management Room Manager's Desks	Lot	1
A8	TIMS Management Room Meeting Table (14-Seater or More)	Lot	1
A9	Call Centre Operator Desks	Lot	1
A10	Security Room Desks	Lot	1
A11	Help Desk Team Desks	Lot	1
A12	Technical Support Team Desks	Lot	1
A13	Meeting Room Furniture (10-Seater or More)	Lot	1
A14	High Back Executive Chair	Lot	1
iv	Building Utilities	-	-
A15	Interior works including fall ceiling, utility duct, Accessories as per requirement (Power Switch Boards, PVC Conduits, Power and Network cables, etc) (Approx. 7500 Sq. Ft)	Lot	1
A16	Access Control System	Nos	4
A17	Fire & Smoke Detection System	Lot	1
A18	Lighting	Lot	1
A19	DG Set for TIMS Control Centre with 72 hours backup	No	1
A20	Air-condition for TIMS Control Centre	Lot	1
A21	UPS Parallel Redundant with Battery backup of 3 hours	Lot	1
A22	CCTV surveillance at TIMS Control Centre	Nos	4
A23	PA system for building	Lot	1
A24	Wi-Fi accessible across control centre	Lot	1
A25	Provision for Sanitization	Lot	1
v	Hardware Components	-	-
	Hardware Components for Data Centre	-	-
A26	Network Racks	Lot	1
A27	Server Racks	Lot	1
A28	Servers- (As per System Design)	Lot	1

Item No.	Description	Unit	Qty
(1)	(2)	(3)	(4)
A29	Internet Server	Lot	1
A30	Load Balancer	Lot	1
A31	Firewall with IPS	Lot	1
A32	Data Storage	Lot	1
A33	SAN Switch	Lot	1
A34	L3 Switch (Copper or/and OFC)	Lot	1
A35	LEVEL 2 Switch (24 Port)	Lot	1
A36	LEVEL 2 Switch (48 Port)	Lot	1
A37	Web Application Firewall (WAF) Appliance with DDOS Protection	Lot	1
A38	Tape Drive	Nos	1
A39	Cartridge Magazine	Lot	1
	Hardware components for Control Centre	-	-
A40	Video Wall Panel, with Controller, 70"	Nos	48
A41	Video Wall Switcher	No	1
A42	Multi-Function Laser Printer – Colour A3, A4 (TIMC Management Room)	Nos	2
A43	Operator Workstations -3 Monitor (TIMC Management Room)	Nos	16
A44	Manager Workstation (TIMC Management Room)	No	1
A45	Help Desk Team Workstations	Nos	2
A46	Technical Support Team Workstations	Nos	4
A47	Call Centre Workstations	Nos	4
A48	Security Room Workstations	Nos	2
A49	Meeting/Situation Room Workstation	No	1
A50	IP Phones	Nos	36
A51	Call Recording Device	No	1
	Software Components at Data Center	-	-
A52	Video wall management Software	Lot	1
A53	Virtualization Software	Lot	1
A54	Centralized Antivirus Software	Lot	1
A55	Access Control System Software	Lot	1
A56	Backup software	Lot	1
A57	CAL, OS, database licence	Lot	1
vi	Network Bandwidth	-	-
	TIMS Network Backbone	-	-
A58	Redundant Bandwidth Cost (For Edge Equipment)	Lot	1
A59	Primary Internet Bandwidth (For TIMS to CBS Data Center)	Lot	1
A60	Primary Internet Bandwidth (For TIMS to DR)	Lot	1
A61	Secondary Internet Bandwidth (For TIMS to CBS Data Center)	Lot	1
A62	Secondary Internet Bandwidth (For TIMS to DR)	Lot	1
vii	ITMS		
A63	ITMS (Application Software)	Lot	1

Item No.	Description	Unit	Qty
(1)	(2)	(3)	(4)
A64	EMS Application	No	1
A65	Website	No	1
A66	Mobile Application (Android & iOS)	No	1
viii	Mandatory Spare Parts		
A67	L3 Switch (Copper /OFC)	Nos	1
A68	LEVEL 2 Switch (24 Port)	Nos	1
A69	LEVEL 2 Switch (48 Port)	Nos	1
A70	SAN-SW	Nos	1
A71	IP Phones	Nos	2
A72	Call Recording Device	Nos	1
ix	Other Items	-	-
A73	Other Items to make system functional and meet SLA	Lot	1
202	Adaptive Traffic Signal Control System (ATCS)	-	-
i	Controller with accessories	-	-
B1	Signal Controller	Nos	165
B2	Controller Cabinet	Nos	165
ii	Detector	-	-
B3	Vehicle Detector	Nos	570
iii	Mounting	-	-
B4	Standard Poles	Nos	716
B5	Cantilever Poles	Nos	567
iv	Aspects & Activation Buttons	-	-
B6	Vehicular Aspect - Red Ball	Nos	1158
B7	Vehicular Aspect - Amber Ball	Nos	1158
B8	Vehicular Aspect - Green Ball / Straight	Nos	953
B9	Vehicular Aspect - Green Arrow Left	Nos	814
B10	Vehicular Aspect - Green Arrow Right	Nos	839
B11	Vehicular Aspect - Red Arrow Right	Nos	260
B12	Vehicular Aspect - Amber Arrow Right	Nos	260
B13	Pedestrian Aspects – Walk	Nos	1154
B14	Pedestrian Aspects - Flashing Don't Walk With Timer	Nos	1154
B15	Pedestrian - Push Button	Nos	1154
B16	Pedestrian Buzzer	Nos	1154
B17	Green U- turn aspect	Nos	57
V	Software	-	-
B18	ATCS Application	Lot	1
vi	Connectivity	-	-
B19	Network Equipment with accessories	Nos	165
vii	Power Requirements	-	-
B20	Outdoor UPS with batteries for 3-hour backup for field elements	Nos	165
viii	Mandatory Spare Parts	-	-
B21	Standard Poles	Nos	46

Item No.	Description	Unit	Qty
(1)	(2)	(3)	(4)
B22	Cantilever Poles	Nos	34
B23	Signal Controller	Nos	10
B24	Controller Cabinet	No	10
B25	Vehicle Detector	Nos	34
B26	Vehicular Aspect - Red Ball	Nos	70
B27	Vehicular Aspect - Amber Ball	Nos	70
B28	Vehicular Aspect - Green Ball / Straight	Nos	58
B29	Vehicular Aspect - Green Arrow Left	Nos	50
B30	Vehicular Aspect - Green Arrow Right	Nos	50
B31	Vehicular Aspect - Red Arrow Right	Nos	16
B32	Vehicular Aspect - Amber Arrow Right	Nos	16
B33	Pedestrian Aspects – Walk	Nos	70
B34	Pedestrian Aspects - Flashing Don't Walk with Timer	Nos	70
B35	Pedestrian - Push Button	Nos	70
B36	Pedestrian Buzzer	Nos	70
B37	Green U - turn aspect	Nos	5
B38	Network Equipment with accessories	Nos	3
B39	Outdoor UPS with batteries for 3-hour backup for field elements	Nos	8
Ix	Other items	-	-
B40	Other items to make system functional and meet the SLA	Lot	1
203	Traffic Incident Detection System (TIDS)	-	-
i	Equipment	-	-
C1	TIDS (Application Software)	Lot	1
C2	TID Camera	Nos	63
C3	PTZ Camera	Nos	58
C4	Controller	Nos	58
C5	Network Equipment with accessories	Nos	58
C6	UPS for 3-hour backup with Batteries and Outdoor junction Box	Nos	58
ii	Material	-	-
C7	Cabinet	Nos	58
C8	Standard Pole	Nos	52
C9	Cantilever Pole	Nos	6
iii	Mandatory Spare Parts	-	-
C10	Cabinet	Nos	3
C11	Standard Pole	Nos	3
C12	Cantilever Pole	Nos	1
C13	TID Camera	Nos	4
C14	PTZ Camera	Nos	3
C15	TIDS Cameras Controller	Nos	3
C16	Network Equipment with accessories	Nos	3

Item No.	Description	Unit	Qty
(1)	(2)	(3)	(4)
C17	UPS for 3-hour backup with Batteries and Outdoor junction Box	Nos	3
iv	Other items	-	-
C18	Other items to make system functional and meet the SLA	Lot	1
204	Variable Message Sign System (VMS)	-	-
i	Equipment	-	-
D1	VMS System (Application Software)	Lot	1
D2	VMS Board with controller and necessary accessories	Nos	17
D3	Network Equipment with accessories	Nos	17
D4	UPS for 3- hours backup with Batteries and Outdoor junction Box	Nos	17
ii	Material	-	-
D5	Cabinet	Nos	17
D6	Gantry	Nos	17
iii	Mandatory Spare Parts	-	-
D7	VMS Board with controller and necessary accessories	No	1
D8	Network Equipment with accessories	No	1
D9	UPS for 3- hours backup with Batteries and Outdoor junction Box	No	1
iv	Other items	-	-
D10	Other items to make system functional and meet the SLA	Lot	1
205	Speed Limit Violation Detection System (SLVD)	-	-
i	Equipment	-	-
E1	SLVD (Application Software)	Lot	1
E2	Doppler Radar and ANPR Camera	Nos	11
E3	IR Illuminator/Flash for SLVD	Nos	11
E4	Local Software for SLVD	Nos	11
E5	LPU for SLVD	Nos	11
E6	Speed Display Board (Radar based)	Nos	11
E7	Network Equipment with accessories	Nos	11
E8	UPS for 3-hours backup with Batteries and Outdoor junction Box	Nos	11
ii	Material	-	-
E9	Cabinet	Nos	11
E10	Standard Pole	Nos	11
iii	Mandatory Spare parts	-	-
E11	Cabinet	Nos	1
E12	Standard Pole	Nos	1
E13	Doppler Radar and ANPR	Nos	2
E14	IR Illuminator for SLVD	Nos.	2
E15	LPU for SLVD	No	1
E16	Speed display (Radar based)	No	1
E17	Network Equipment with accessories	No	1

Item No.	Description	Unit	Qty
(1)	(2)	(3)	(4)
E18	UPS for 3 -hours backup with Batteries and Outdoor junction Box	No	1
iv	Other items	-	-
E19	Other items to make system functional and meet the SLA	Lot	1
F	Red Light Violation Detection System (RLVD)	-	-
i	Equipment	-	-
F1	RLVD System (Application Software)	Lot	1
F2	ANPR Camera (One per lane)	Nos	439
F3	IR Illuminator for ANPR	Nos	439
F4	RLVD Camera	Nos	165
F5	Local Software for ANPR	Nos	439
F6	Local Software for RLVD	Nos	165
F7	LPU for RLVD & ANPR	Nos	165
F8	Network Equipment with accessories	Nos	50
F9	UPS for 3h backup with Batteries and Outdoor junction Box	Nos	50
ii	Material	-	-
F10	Cabinet	Nos	50
F11	Gantry (U-Type)	Nos	135
F12	Cantilever Pole (L-Type)	Nos	30
iii	Mandatory Spare Parts	-	-
F13	Cabinet	Nos	3
F14	Gantry (U-Type)	Nos	1
F15	Cantilever Pole (L-Type)	Nos	2
F16	ANPR Camera (One per lane)	Nos	23
F17	IR Illuminator for ANPR	Nos	23
F18	RLVD Camera	Nos	12
F19	LPU for RLVD & ANPR	Nos	12
F20	Network Equipment with accessories	Nos	3
F21	UPS for 3- hours backup with Batteries and Outdoor junction Box	Nos	3
iv	Other items	-	-
F22	Other items to make system functional and meet the SLA	Lot	1
G	Automatic Traffic Cum- Counter (ATCC)	-	-
i	Equipment	-	-
G1	ATCC1 System (Application Software)	Lot	1
G2	ATCC2 System (Application Software)	Lot	1
G3	Image Recognition Detector	Nos	230
G4	Processing Unit	Nos	230
G5	Network Equipment with accessories	Nos	230
G6	UPS for 3- hours backup with Batteries and Outdoor junction Box	Nos	230
ii	Material	-	-

Item No.	Description	Unit	Qty
(1)	(2)	(3)	(4)
G7	Cantilever Pole with Dual Arm	Nos	54
G8	Cantilever Pole with Single Arm	Nos	117
G9	Cabinet	Nos	171
iii	Mandatory Spare Parts	-	-
G10	Cantilever Pole with Dual Arm	Nos	3
G11	Cantilever Pole with Single Arm	Nos	6
G12	Cabinet	Nos	6
G13	Image Recognition Detector	Nos	12
G14	Processing Unit	Nos	12
G15	Network Equipment	Nos	12
G16	UPS for 3h backup with Batteries and Outdoor junction Box	Nos	12
iv	Other items	-	-
G17	Other items to make system functional and meet the SLA	Lot	1
208	Computer Aided Dispatch/ Automatic Vehicle Location System (CAD/AVL)	-	-
i	CAD/AVL Software		
H1	CAD/AVL Central Application	Lot	1
H2	EMS Application	Lot	1
ii	CAD/AVL Hardware	-	-
H3	Onboard ITS Device (SCU & BDC)	Nos	2940
H4	SIM Cards	Nos	2940
H5	Cable Between onboard ITS device and CANBus Port	Nos	2940
H6	Workstation at Depot - with 21" dual monitor	Nos	31
H7	UPS for 3 hours backup with Batteries	Nos	31
iii	CAD/AVL Mandatory Spare Parts	-	-
H8	Onboard ITS Device (SCU&BDC)	Nos	147
H9	Workstation at Depot - with 21" dual monitor	Nos	2
H10	UPS for 3 hours backup with Batteries	Nos	2
iv	Other items	-	-
H11	Other items to make system functional and meet the SLA	Lot	1
209	Passenger Information System (PIS)		
i	PIS Software	-	-
I1	PIS Software with ETA/ETD calculation	No	1
I2	Commuter Website	No	1
I3	Commuter SMS System	No	1
I4	Commuter Mobile Application (Android & iOS)	No	1
ii	PIS Hardware	-	-
I5	Type A - PIS - LED boards at Terminals	Nos	20
I6	Type B - PIS - LED 4 Line boards	Nos	96
I7	Type C - PIS - LED 2 Line boards	Nos	500
I8	Pole	Nos	20

Item No.	Description	Unit	Qty
(1)	(2)	(3)	(4)
I9	SIM Cards	Nos	616
I10	UPS for 3 hours backup with Batteries and Outdoor junction Box	Nos	20
I11	UPS for 1 hour backup for 4-line and 2-line boards with Batteries and Outdoor junction Box	No	596
iii	PIS Mandatory Spare Parts	-	-
I12	Type A - PIS - LED boards at Terminals	No	1
I13	UPS for 3 hours backup with Batteries and Outdoor junction Box	Nos	1
I14	Type B - PIS - LED 4 Line boards	Nos	5
I15	Type C - PIS - LED 2 Line boards	Nos	20
I16	UPS for 1 hour backup for 4-line and 2-line boards with Batteries and Outdoor junction Box	Nos	25
iv	Other items	-	-
I17	Other items to make system functional and meet the SLA	Lot	1
210	Depot Management System (DMS)		
i	DMS Software	-	-
J1	Vehicle Planning and Scheduling	No	1
J2	Vehicle Dispatch and Crew Rostering	No	1
J3	Attendance Management System	No	1
J4	MTC Staff Mobile Application (Android & iOS)	No	1
ii	DMS Hardware	-	-
J5	Workstation at Depot - with 21" single monitor	Nos	31
J6	Printer Laser – A4	Nos	31
J7	Biometric Reader	Nos	62
J8	UPS with 3 hours backup for DMS Workstation & Printer	Nos	31
iii	Mandatory Spare Parts	-	-
J9	Biometric Reader	Nos	4
J10	Workstation at Depot - with 21" single monitor	Nos	2
J11	UPS with 3 hours backup for DMS Workstation & Printer	Nos	2
iv	Other items	-	-
J11	Other items to make system functional and meet the SLA	Lot	1
211	CBS Command Control Centre	-	-
i	Control Centre Room	-	-
K1	IP PABX/EPABX System including 2 - PRI lines	No	1
K2	Land Line Phone (IP phone Video Phones)	Nos	14
ii	Meeting Room	-	-
K3	70" LED display	No	1
iii	Furniture	-	-
K4	Control centre Table and Chair as per the proposed layout	Lot	1
iv	Building Utilities	-	-
K5	Fire & Smoke Detection System	Lot	1
K6	Lighting	Lot	1

Item No.	Description	Unit	Qty
(1)	(2)	(3)	(4)
K7	DG Set CBS (ITS equipment Load Only) 72 hours backup	No	1
K8	100% parallel redundant UPS with 3 hours backup	Lot	1
K9	CCTV surveillance at CBS Control Centre	Nos	4
K10	Wi-Fi accessible at control Center	Lot	1
K11	Provision for Sanitization	Lot	1
K12	Interior works including fall ceiling, utility duct, Accessories as per requirement (Power Switch Boards, PVC Conduits, Power and Network cables, etc) (Approx. 2500 Sq. Ft)	Lot	1
v	Hardware Components	-	-
K13	Network Racks	Lot	1
K14	Server Racks	Lot	1
K15	Servers (AVL, PIS & DMS)	Lot	1
K16	Internet Server	No	1
K17	Load Balancer	No	1
K18	Firewall with IPS	Nos	2
K19	Data Storage	Lot	1
K20	SAN Switch	No	1
K21	L3 Switch (Copper + OFC)	Nos	2
K22	LEVEL 2 Switch (48 Port)	Nos	2
K23	Web Application Firewall (WAF) Appliance + DDOS Protection	No	1
K24	Tape Drive	No	1
K25	Cartridge Magazine	Lot	1
vi	Hardware components for Control Centre	-	-
K26	Video Wall Panel, with Controller, 70" (3x3)	No	1
K27	Video Wall Switcher	No	1
K28	Network LaserJet Printer - A3 & A4 paper	No	1
K29	All in One Printer (Colour Print, Copy, FAX)	No	1
K30	Workstation for CAD/AVL & PIS with 21" dual Monitor	Nos	22
K31	Technical Support Team Laptop	Nos	4
vii	Software Components at Data Centre	-	-
K32	Video wall management Software	Lot	1
K33	Virtualization Software	Lot	1
K34	Centralized Antivirus Software	Lot	1
K35	Backup software	Lot	1
K36	CAL, OS, database licence as per design	Lot	1
viii	Network Bandwidth	-	-
	CBS Network Backbone	-	-
K37	Primary Connectivity (Mpls or Leased line)	Lot	1
K38	Secondary Connectivity (Mpls or Leased line)	Lot	1
ix	Mandatory Spare Parts		
K39	L3 Switch (Copper + OFC)	Nos	1
K40	LEVEL 2 Switch (48 Port)	Nos	1

Item No.	Description	Unit	Qty
(1)	(2)	(3)	(4)
K41	SAN-SW	Nos	1
K42	Land Line Phone (IP phone Video Phones)	Nos	1
K43	Hands free/Headphone for dispatchers	Nos	1
x	Other Items	-	-
K44	Other Items to make system functional and meet SLA	Lot	1

2 On site Installation, Training and Testing

Item No.	Description	Unit	Qty
301	Chennai Traffic Information & Management System Command Control Centre (TIMS-CCC)	-	-
A1	Installation to meet functional requirement	Location	1
A2	Test and Commissioning	Location	1
A3	Training	Lot	1
A4	Safety measures items	Lot	1
A5	Other items to make system functional and meet SLA	Lot	1
302	Adaptive Traffic Control System (ATCS)	-	-
B1	Installation including power supply, cabling and wiring, grounding/earthing, protection against lightning, cabinet/junction box, support structure, radio interference, road signs and markings and necessary civil works etc to meet the functional requirement	Location	165
B2	Test and Commissioning	Location	165
B3	Training	Lot	1
B4	Safety measures items	Lot	1
B5	Other items to make system functional and meet SLA	Lot	1
303	Traffic Incident Detection System (TIDS)	-	-
C1	Installation including power supply, cabling and wiring, grounding/earthing, protection against lightning, cabinet/junction box, support structure, radio interference, road signs and markings and necessary civil works etc to meet the functional requirement	Location	58
C2	Test and Commissioning	Location	58
C3	Training	Lot	1
C4	Safety measures items	Lot	1
C5	Other items to make system functional and meet SLA	Lot	1
304	Variable Message Sign System (VMS)	-	-
D1	Installation including power supply, cabling and wiring, grounding/earthing, protection against lightning, cabinet/junction box, support structure, radio interference, road signs and markings and necessary civil works etc to meet the functional requirement	Location	17
D2	Test and Commissioning	Location	17
D3	Training	Lot	1
D4	Safety measures items	Lot	1

Item No.	Description	Unit	Qty
D5	Other items to make system functional and meet SLA	Lot	1
305	Speed Limit Violation Detection System (SLVD)	-	-
E1	Installation including power supply, cabling and wiring, grounding/earthing, protection against lightning, cabinet/junction box, support structure, radio interference, road signs and markings and necessary civil works etc to meet the functional requirement	Location	11
E2	Test and Commissioning	Location	11
E3	Training	Lot	1
E4	Safety measures items	Lot	1
E5	Other items to make system functional and meet SLA	Lot	1
306	Red Light Violation Detection System (RLVD)	-	-
F1	Installation including power supply, cabling and wiring, grounding/earthing, protection against lightning, cabinet/junction box, support structure, radio interference, road signs and markings and necessary civil works etc to meet the functional requirement	Location	50
F2	Test and Commissioning	Location	50
F3	Training	Lot	1
F4	Safety measures items	Lot	1
F5	Other items to make system functional and meet SLA	Lot	1
307	Automatic Traffic Cum-Classifer (ATCC)	-	-
G1	Installation including power supply, cabling and wiring, grounding/earthing, protection against lightning, cabinet/junction box, support structure, radio interference, road signs and markings and necessary civil works etc to meet the functional requirement	Location	171
G2	Test and Commissioning	Location	171
G3	Training	Lot	1
G4	Safety measures items	Lot	1
G5	Other items to make system functional and meet SLA	Lot	1
308	Computer Aided Dispatch/ Automatic Vehicle Location System (CAD/AVL)	-	-
H1	Installation including cabling and wiring, etc to meet functional requirement	Bus	2940
H2	Test and Commissioning	Bus	2940
H3	Training	Lot	1
H4	Safety measures items	Lot	1
H5	Other items to make system functional and meet SLA	Lot	1
309	Passenger Information System (PIS)	-	-
I1	Installation including power supply, cabling and wiring, grounding/earthing, protection against lightning, cabinet/junction box, support structure, radio interference, road signs and markings and necessary civil works etc to meet the functional requirement	Location	616
I2	Test and Commissioning	Location	616
I3	Training	Lot	1
I4	Safety measures items	Lot	1

Item No.	Description	Unit	Qty
I5	Other items to make system functional and meet SLA	Lot	1
310	Depot Management System (DMS)	-	-
J1	Installation including to meet functional requirement	Location	31
J2	Test and Commissioning	Location	31
J3	Training	Lot	1
J4	Safety measures items	Lot	1
J5	Other items to make system functional and meet SLA	Lot	1
311	CBS Command Control Centre	-	-
K1	Installation to meet functional requirement	Location	1
K2	Test and Commissioning	Location	1
K3	Training	Lot	1
K4	Safety measures items	Lot	1
K5	Other items to make system functional and meet SLA	Lot	1

Chapter 5 Drawings

Refer the drawings provided as separate volume

- 1) Part 2 – Employers requirements –
Section VII. Technical Requirements
Drawing for references – Vol 1
- 2) Part 2 – Employers requirements –
Section VII. Technical Requirements
Drawing for references – Vol 2

Section VIII Operation and Maintenance Requirements

1 Introduction

Operation and Maintenance of CITS Project shall be executed in the manner originally intended, that is to collect and analyze the traffic and bus operations data into useful information, disseminate the information to road users and public transport commuters in accordance with the procedures as set forth herein and instructions given by the Engineer and Employer time to time during the Project period. The system shall be in operation for 24 hours a day and 7 days a week without interruption. The Contractor shall not divert and modify the procedure without written approval by the Employer, and Engineer.

The purpose of Operation and Maintenance of system is to keep the traffic information and management system (TIMS) and city bus system (CBS) and related facilities in operation in the manner originally intended, that is to collect and analyze the traffic and bus operations data into useful information, disseminate the information to road users and public transport commuters and to prolong the life of the system and the equipment. Therefore, time is of essence. Repair must be done in a timely manner.

The specifications described herein shall be considered the minimum standards to be followed for the maintenance and repair of all equipment's, facilities, tools etc covered under the Contract. Unless otherwise specified, the standards for equipment and equipment performance shall be in accordance with the Technical Specification of Employer's Requirements

2 Scope of Works

Apart from installation of scope delivered by the Contractor also includes Operation and Maintenance, Manpower, Spare parts inventory for a period of 60 Months from the date of completion of trial run and acceptance which includes 24 Months of Defects Notification Period.

Except otherwise specified in the Operation & Maintenance Specifications of Employer's Requirements, it is the Contractor's responsibility to provide sufficient manpower to implement flawless execution of CITS Project and related systems under this Contract in operation in the manner originally intended, that is to collect road, traffic data to process and analyses useful information, disseminate the information to road users and undertake the Services that are not specifically mentioned in these requirements but essential for the safe and efficient traffic operation on the Chennai ITS under this contract.

The Contractor shall maintain qualified staff at the Command-and-Control Center with require necessary, tools, shop facilities, equipment, consumables, transportation and materials and perform all works necessary to maintain in good working manner of system and associated equipment under this contract.

2.1 Operation and Maintenance service Proposal

The Contractor shall describe the methodology and outline to execute proposed Services both Operation & Maintenance in sufficient detail in his Services Proposal to enable the Employer to evaluate the technical capability and qualification of the Contractor and to judge whether the proposal is adequately responsive or not.

The Contractor shall update and furnish the Service Proposal two (2) months before expected

starting date of Operation period for approval by The Engineer and Employer.

The Services Proposal shall describe the operation and maintenance activities taking Manufacturer or OEM recommendations for all hardware and software into consideration and shall be written in the same sequence as the Employer's Requirement. Where the supporting documents such as brochure, article, report, or paper are provided, they shall be attached at the end of the proposal or in a separate volume and a cross reference shall be prepared. The Services Proposal shall be written in English.

This plan shall be updated as necessary during the O&M period so as to reflect the actual conditions of O&M

The Operation and Maintenance proposal also includes the Manpower deployment schedule in accordance with the requirement defined in this document.

2.2 Main requirement for Operation & Maintenance service

Main requirement for Operation & Maintenance service but not limited are;

- Operation & Maintenance of the system under this contract
- Emergency Response and recovery of the system
- Periodic Inspection, Preventive Maintenance, and Corrective Maintenance
- Upgrading software
- SLA Monitoring and Management
- Call Center & another day-to-day operation
- Spare parts management
- Training
- Helpdesk services
- Any other as necessary or desired in order to maintain the SLA

2.3 Sub-system for Operation & Maintenance service

Operation & Maintenance services are required to cover the following sub-system;

Two Command and Control Center one for TIMS and another for CBS at the respective

Locations. Traffic Information and Management System (TIMS)

- Adaptive Traffic Signal System (ATCS)
- Traffic Incident Detection System (TIDS)
- Red Light Violation Detection System (RLVD)
- Speed Limit Violation Detection System (SLVD)
- Variable Message Sign (VMS)
- Automatic Traffic Counter and Classifier (ATCC)
- Command Control Center (TIMS-CCC)

City Bus System (CBS)

- Automatic Vehicle location System (AVL)
- Passenger Information System (PIS)
- Depo Management System (DMS)
- Command Control Centre (CBS-CCC)

Others

- Network monitoring and Management
- Power Supply and Management
- hardware and software, and other related facilities, tools, equipment's and infrastructure etc. installed as part of the CITS project during the Contract Period.
- Any other items covered under this contract during the project period

3 General Requirement

The specifications described herein shall be considered the minimum standards to be followed for the maintenance and repair of all equipment and software covered under the Contract. Unless otherwise specified, the standards for equipment and equipment performance shall be in accordance with the Technical Specification.

3.1 The Contractor's Personnel

3.1.1 Key Personnel

For the purpose of discharging its obligations under the Contract, the Contractor shall recruit and deploy the specified number of key personnel, non-Key staff, full time or intermittent of suitable qualification and experience as described in this document. The Contractor shall ensure that the key personnel deployed are of good health, of highest integrity, punctual, well dressed, well behaved and of qualification and experience prescribed in the Employer requirement table given in this document. The CV submitted for the key staff will be considered for evaluation of the Contractor capability.

Frequent replacement of key personnel is not desirable unless they are found involved in malpractices or non-compliances. However, a permission of replacement of key personnel shall be obtained from the Engineer in advance together with the request for approval of replacement. The Engineer, if satisfied with the reasons submitted to him, may allow such replacement after verifying the CVs strictly in accordance with the requirements.

The Indicative List of Personnel given in Section VI. General Requirement. however, the Contractor shall mobilize the requisite additional personnel according to the site condition during the Project Period with a written request to the Engineer and Employer and subsequent approval.

3.1.2 Non- Key Personnel

For the purpose of discharging its obligations under the Contract, the Contractor shall recruit and deploy the specified number of Non- key personnel of suitable qualification and experience. The Contractor shall ensure that the key personnel deployed are of good health, of the highest integrity, punctual, well dressed, well behaved, and of qualification and experience prescribed hereunder.

The frequent replacement of Non- key personnel is not desirable unless they are found involved in malpractices or non-compliances. However, the permission of replacement of Non-key personnel shall be obtained from the Engineer in advance together with the request for approval of replacement. The Engineer, if satisfied with the reasons submitted to him, may allow such replacement after verifying the CVs strictly in accordance with the requirements and better than original.

The Indicative List of Personnel given in the table below however, the Contractor shall mobilize the requisite additional personnel according to the site condition during the Project Period with a written request to the Engineer and Employer and subsequent approval.

3.1.3 Deployment of Personnel

The Contractor shall recruit and deploy suitable personnel as outlined in this document during the operation and maintenance in the Employer Requirement. The manpower shown is minimum in number of Key Personal and Non-Key personal having fulltime and intermittent inputs along with Field Support Engineers and staffs, however the Contractor shall deploy additional manpower in order keep the Operation and Maintenance services as intended in the Employer Requirement.

The Contractor shall furnish to the Employer and Engineer, in addition to the list of key personnel provided with the tender, a list of persons deployed for the purpose of discharging its obligations under the Contract, containing all the details like their educational qualifications, experience, training undergone, and recent photograph.

The Employer reserves its right to object to the deployment of any personnel for any reason. In such case, the person or persons being objected to by the Employer shall be removed by the Contractor forthwith and replace.

The Employer shall not be liable for any misconduct or misdeeds or any act or incident involving the Contractor or any of its personnel in any criminal or civil case. The Contractor shall be responsible for consequences and if any such incident takes place, the Contractor shall forthwith intimate the said incident to the Employer.

The Contractor shall employ Project Director, Project Managers and the suitable number of operators. The temporary number of these staff and the tasks assigned to them estimated by Employer is shown in this RFP. It shall be noted that the number indicated in the table is the minimum requirements by Employer and it is the Contractor's responsibility to provide high quality service seamlessly and effective staff arrangement shall be recruited if necessary. International Staff shall carry out the technology transfer as an important aspect including CITS Project technology through operation and maintenance works to Employer and Contractor's local staffs.

The staff member shown in this RFP is the persons directly engaged in the CITS Project Operation and Maintenance Services and the Contractor shall recruit and deploy the necessary number of managers, operators and technicians.

The Contractor shall provide all personnel necessary for performing the CITS Project operation and maintenance by the personnel listed in Table. The Contractor shall submit curriculum vitae of the candidate non-key person for the Engineer's approval two (2) months in advance of the start of operation and maintenance work. These engineers shall be involved in the installation, adjustment, test on completion and training of the Stakeholder Organisation staff of the CITS Project to be supplied under the Contract.

The Contractor shall submit the list of all CITS Project Operation and maintenance staff with name, birth date and address together with copy of ID every month to the Engineer. If there is any change in the composition of the operation and maintenance staff, it shall be reported immediately to the Employer. The Employer will issue an ID to each staff member. The Contractor shall be responsible for the proper use of the ID to gain the access to the access-controlled places and system facilities and return it immediately if a staff member no longer works for the CITS Project Operation and maintenance.

During O&M period, The Contractor shall submit the system generated attendance record of each employee deployed at the locations with each service invoice. The Engineer shall have the access to the logs of biometric attendance management system for verification of the actual manpower working days in a month. The amount against manpower will be payable only for the duration the O&M personnel will be available at site. In case the required manpower is not available at any location for more than 15 days in a month, no payment shall be made against manpower (as quoted in the financial bid) for that location for whole month, apart from other deductions / penalties as applicable.

3.1.4 Penalty for delay in Manpower Mobilisation

- Delay in submission of detailed written statements and/or mobilization of aforesaid Key Personnel shall attract penalty @ INR 1,00,000/- (Rupees One Lacs) per day per Key Personnel
- In case the delay is more than 3 weeks, the Employer reserves the right to encash the Performance Security towards the aforesaid penalty and may proceed with termination of the project, as the case may be.

3.1.5 Penalty for Replacement of Manpower

The Manpower proposed shall be dedicated to the project and shall not be proposed for any other project or assigned any other project. The resource cannot be changed for at least two years.

In case of any variation or change in the manpower/person proposed in the Technical Proposal and manpower/person deployed upon successful award of the works, minimum of 20% remuneration of the proposed role for the total contract period shall be deducted.

The substitute proposed by the Contractor must propose for equivalent or better than the proposed candidate in all respect (no. of years of relevant experience, no. of similar projects executed, qualification of the replacement candidate, etc.).

The Maximum replacement 20% of Key staff and Non-key staff shall be allowed during the Project Period under normal circumstances. If the situation beyond the control of the Contractor, the necessary approval must be taken by the Contractor from the Engineer/Employer.

3.1.6 Working Shift

Two-shift (+1 backup person) system shall be adopted for TIMS and CBS operation. The tentative shifts are as shown below.

- First shift: 05:45 - 14:00 hours
- Second shift: 13:45 - 22:00 hours

3.1.7 Welfare of Contractor's Employee

The Contractor shall be solely responsible and liable for complying with statutory liability for welfare of the employees such as ESI, EPF, workmen's compensation, wages, bonus medical leave, etc.

However, if considered necessary, the Employer shall have every right to enquire and seek documentary evidence from the Contractor to confirm, whether all the statutory dues like ESI, EPF, minimum wages, weekly offs, bonus, medical leave, workman compensation and any other entitlements, in accordance with the statutory dues applicable in the area are being paid.

3.2 Safety, Security and Protection of Environment

Throughout the period of Contract, the Contractor shall have full regard for safety of all persons entitled to be upon the CCC area and for the avoidance of danger to such persons specially from moving traffic. All staff employed by the Contractor shall receive the training on the work area safety before assigned to the position. The Contractor shall provide all necessary safety equipment such as reflective vests, hard hats, etc to the persons.

3.3 Employer's Equipment and Property

3.3.1 Provision of Equipment and Property

In order to enable the Contractor to discharge its duties of TIMS Operation and Maintenance Services and CBS Operation and Maintenance Services efficiently and uninterruptedly, the Employer shall provide such infrastructural facilities including Traffic Information and Management System hardware and software as may be considered appropriate by the Employer and CBS System by MTC.

3.3.2 Care of Equipment

The Contractor shall use the Employer's equipment and property that the Contractor is allowed to use with utmost care and attention. If the equipment or property under custody of the Contractor becomes inoperative or defective due to the inappropriate operation or use of them by the Contractor's staff, the Contractor shall repair or replace them at his own cost after obtaining the instruction from the Employer as to the remedial measure to be taken.

If any liability or obligation with regard to the repair or replacement of Employer's equipment and property is remained unfulfilled by the Contractor at the time of return upon termination of the Contract, the amount necessary for the repair or replacement shall be deducted to the payment due to the Contractor. All consumables including but not limited to the printer paper and printer toner shall be arranged and purchased by the Contractor at his own cost.

3.3.3 Power supply and Communication

The Contractor shall make necessary arrangements for provision of power supply at all field locations, server room and CCC.

The Contractor shall make necessary arrangements for provision of Communication at all field locations, server room, CCC, DC, DR, Exchange Information etc..

The Contractor shall perform all the necessary application procedures to the Power Company required for the power to be supplied to the Chennai Traffic Information & Management System Command

Control Centre (TIMS-CCC), City Bus System Command Control Centre (CBS-CCC), and all the field equipment's. All the expenses charged by Power Companies regarding such applications shall be borne by the Contractor. The Contractor shall make all necessary arrangements for to the electricity needed for smooth Operation and maintenance of CITS Project for the entire period of the Contract.

The fixed charges, installation charges, recurring charges, electricity bill, maintenance etc. for each field equipment, TIMS-CCC, CBS-CCC, Contractor's site office, or any other facility being used by the Contractor under the scope of this Contract shall be in the scope of the Contractor only for the entire Contract period i.e. Design phase, procurement, installation, testing, trail-run, commissioning, operations and maintenance period. The Employer shall not responsible for any provision for power supply during implementation as well as operations and maintenance period. last mile connectivity work shall be completed before start of the operation and Maintenance services for CITS Project during theproject period.

3.4 Inspection and Evaluation

3.4.1 Inspection

The Employer reserves the right to conduct inspection of the Contractor's work at any time without prior notice, to check, observe, and witness the activities of the Contractor at CCC.

The Contractor shall permit the Employer's Representative at any time or times during the execution ofthe Contract to enter upon any place where the Contractor is allowed to access within the Employer's premises for the purpose of inspection or for any other legitimate purpose. The Contractor shall give allrequired information and inspection of records to the Engineer regarding the operation of the Traffic Information and Management System, if asked for.

The purpose of the inspection is to monitor the Contractor's activities and to ensure that all the activitiesrequired under the Contract are being carried out properly by the personnel deployed by the Contractor. The Employer may exercise any check control to ensure discharge of various obligations by the Contractor under the Contract including but not limited to following:

1. Adherence to operation procedure stipulated in the operation manuals;
2. Promptness and responsiveness to Emergency call;
3. Promptness and adequateness to communicate with other organizations;
4. Handling of the system and equipment;
5. Adequateness and promptness of VMS message;
6. Adequateness of record keeping;
7. Cleanness and tidiness of the CCC and the rooms that are used by the Contractor's staff;
8. Traffic safety awareness; and
9. Any other check or control as considered

3.4.2 Evaluation by Employer

The Employer will conduct from time to time the evaluation of the TIMS & CBS Operation and Maintenance Service provided by the Contractor under the Contract based on the performance of service level parameters specified in Service level Table.

4 Operation Requirements

The various type of operation related services to be performed by the Contractor shall include the following:

4.1 Standard Operating Procedures

The CITS system is designed and implemented to be up and running for 24 X 7 operations, therefore the staffs are required to be placed in shifts as required. The shift would be varying personnel depending on peak and non-peak traffic pattern and based on requirement from the authorities on weekends and weekdays respectively.

The daily operational activity carries out concerning both Command Control Center (TIMS & CBS). For successful operation and maintenance, Contractor shall define the in minimum standard procedure in consultation of Engineer/Employer but not limited.

- Jurisdiction of the TIMS/CBS with maps
- Organization structure and reporting relationships
- Hours of operation, shift details, staff deployment during various shifts
- Emergency and other contact numbers
- Details regarding capturing log of various operational activities
- Responsibilities of various agencies
- The role description of various positions
- Coordination mechanism with various agencies
- Facility and building management aspects such as utilities, services, etc.
- Procedures for notifications
- Data backup and archival policies
- Asset custody and maintenance related procedures
- Access control mechanism
- Data and asset security
- Communication with Media
- Communication infrastructure
- Procedure for bypassing any policy requirements
- Handling visitors
- Office Administration
- Training requirements
- Other TIMS/CBS manuals
- Call Centre detail Operation procedure
- Reporting and review of performance metrics
- Reporting Application Availability of Average loading time of transaction and Average report loading
- Security testing for Vulnerability assessment
- Any other function as desired by the Employer time to time

The Sop's shall be evaluated from time to time with the Employer as well as the Engineer and inline needs to be updated for better operation and performance. Contractor shall conduct periodic training or indeed

4.2 TIMS Operation

The TIMS Operation shall be executed in accordance with the procedures as set forth herein and instructions given by the Chennai Traffic Police (CTP). The system shall be in operation for 24 hours a day and 7 days a week without interruption. The Contractor shall not divert and modify the procedure without written approval by the CTP.

4.2.1 Briefing at shift change

Shift time of operators shall be arranged in such a way that there will be an overlapping period of at least 15 minutes. During the overlapped period, new operation team shall be briefed or shall review the status and notes shared by the previous operation team as to the following:

- General traffic condition
 - Weather condition
 - Existing incidents and accident being disposed of
 - On-going and scheduled works in the City
 - On-going and scheduled events in the City and major roads along with critical junctions
 - Messages being displayed on VMS
 - Equipment malfunctioned and the status of maintenance work
 - Other matters that need attention of the operation team
-

4.2.2 Confirmation of equipment condition

At the start of a shift, operators shall confirm the condition of all equipment through operation or through the consoles. If there is a new failure that was not reported by the previous shift team, the operator shall record it and report it to the maintenance team for proper maintenance action. During the operation of the system, if the operator detects any abnormality of the equipment, software, or database, he shall report it to the maintenance team for proper maintenance action. The operator shall refrain from manipulating equipment, modifying operating parameters, reloading software, or other action without instruction by the maintenance staff when abnormal or defective behavior of the equipment or software is found.

If the fault signal or no diagnosis signal response from roadside equipment is received at CCC, operators shall contact the maintenance team and report the location and status of equipment with failure.

4.2.3 Operation of ATCS

Monitor the operation of traffic signals and take suitable interventions as per the traffic situation and incidents and as required, such as change in signal plan, change of signal timing to reduce the congestion from TIMS-CCC enabling green corridor, Plan for Traffic Diversions, or any others measures to improve the traffic flow etc. Periodic change of signal plans and other configurations parameters on directions of Authority (CTP) including following operation.

- Planning of Traffic Movement
- Design of timing plans
- Operation and Management of Traffic Signals
- Review and support to the Employer by the Contractor on Signaling Operations
- System Audit and Fine Tuning of ATCS parameters
- Monitor health of traffic signal equipment and initiate immediate corrective action in any of any fault.

4.2.4 Operation of Incident Management and Traffic Information Dissemination

(1) Manual Incident Management

When the Operator receives the information from the Help desk and relevant agencies on lane closure, accident, fallen object, construction work, stalled vehicle, pavement problem, adverse weather, fire nearby, etc, Operator shall review the information and generate and resist incidents manually. All alerts, incidents shall be acknowledged, and corresponding responsive action shall be undertaken as per the type of incident.

(2) Automatic Incident Management

When Operator receives the incident information (heavy congestion and traffic incident detected by TIDS) automatically, the Operator shall review the incidents generated by the TIDS system or related sub-system. All alerts, incidents shall be acknowledged, and corresponding responsive action shall be undertaken as per the type of incident.

(3) Other Incident

Any other incident as defined by the Employer time to time

4.2.5 Operation of RLVD & SLVD

- The operator shall review the violations reported by RLVD & SLVD systems and forward them authentic violations to the concerned enforcement officer for the outcome.
 - Process e-challans for the violation captured by RLVD & SLVD, including generation, verification, and data availability of e-challans.
-

- Track specified vehicles (stolen vehicles or vehicles involved in crimes) based on RLVD/SLVD data.

4.2.6 Operation of VMS

Operators shall exercise utmost care while posting/updating the appropriate messages and images specifically in the selection of messages/words depicted to the road users. The operator shall ensure removal of messages posted after the restoration to normal traffic condition

The operator shall disseminate messages on VMS related to.

- Cautionary Messages
 - Incidents Status
 - Traffic Condition in the downstream location
- Informatory Messages
 - Travel Time Messages
 - Safety Messages

Operator shall manage the message function on VMS related to.

- Create message management
 - Compose message combination
 - Select readily available message and modify
 - Create display image
- Priority management
 - Link area management
 - Seriousness of incidents and the distance

4.2.7 Operation of ATCC and Review of Traffic Situation

The operator shall ensure the collection of data goes unhindered; the threshold values that are used to detect abnormal traffic conditions shall be reviewed from time to time to confirm that the values are appropriate. The traffic counts and classification provided by ATCC will have to be compared with manual traffic surveys for sample durations to the calculation of accuracy.

4.2.8 Data analysis and sharing

All the system data collected shall be analyzed in an effective way to achieve the project goals and betterment of the city. The data shall be available in the required format for sharing with any other stakeholder agency in the required format.

4.2.9 Set up a Call Centre for public help

Call center for communication, emergency information, transportation requirement with public and other team and communication for information sharing and exchange with relative stakeholders

4.3 CBS Operation

The public transport buses for Chennai city is managed and operated by Metropolitan Transport Corporation. Currently, the operations team of MTC manages its fleet of around 3500 buses operated from 31 depots and 9 regions. As part of this project, the City Bus System is being procured for supporting effective operations and provide reliable real-time information to commuters.

City Buses operate from 5 AM to 11 PM daily. Currently, each of the regions is managing the daily routine operational activities covering two operational shifts.

The CBS operations shall be managed by the Employer's team. The Contractor shall ensure the availability of the corresponding systems and software. The Contractor's personnel shall support the operations conducted by Employer's personnel. The Contractor's Key Personnel for CBS shall review the operations and shall provide inputs on the improvements to be

undertaken and also recommend the best practices to be followed.

The expected daily operations for CBS areas by Employer but supported by Contractor are outlined below.

- Vehicle Planning
 - Ensuring availability of Buses for operations
 - Allocation of Buses for operations

- Scheduling
 - Operational Bus Schedules/Trips
 - Assignment of Buses to Schedule / Trips
 - Assignment of Crew to Buses
- Dispatch of Buses from Depots
- Monitoring of Bus operations – schedule/trip adherence, skipping stops, early departures, bunching of buses, disruptions, etc
- Manage dispatch of buses as per demand
- Review of Passenger Information dissemination through website, helpdesk, etc
- Reporting and review of performance metrics

5 Maintenance Requirements

The various type of maintenance and repair works and related services to be performed by the Contractor shall include the following:

- Preventive Maintenance of all sub-systems
- Ensuring uptime and connectivity of the field equipment
- Review and reporting of any issues on the connectivity of field equipment
- Repair of faulty and breakdown equipment
- Management of warranties and AMCs of all hardware
- Review of hardware performance and necessary corrective maintenance action for the upkeep of the same
- Management of software/firmware updates and patches for all subsystems and hardware

5.1 General Requirement for Maintenance

5.1.1 Inspection of Faulty Parts

The Contractor shall inspect the faulty part retrieved from the equipment repaired and prepare and submit a report describing the nature of the failure to the Engineer together with his opinion whether the failure is caused by defect, inadequate operation, act by the third party, normal wear and tear or other reasons.

(1) Malfunction (Fault) Report and Work Order

Each corrective maintenance and accident repair work shall be documented on the Malfunction (Fault) Report form and work order form by the Contractor. The Contractor shall prepare and submit the form together with the list of inspection items for the approval of the Engineer. A copy of completed work order forms shall be submitted with the Monthly Progress Report. No payment shall be made without submitting the completed work order forms in Quarterly progress report and quarterly Invoice. The Fault Reports shall be kept in a logbook and shall be made available to the Engineer upon request at any time.

(2) Maintenance and repair records

The Contractor shall maintain a comprehensive record of all maintenance and repair activities and spare parts consumptions and inventory. The records shall include minimum maintenance checklists, fault reports, spare parts receiving and consumption records, and work orders. These records shall be kept in a database and various operations including but not limited to search and retrieval of fault record by specified key, statistical processing of records into performance index, and calculation of MTBF, MTTR, and other parameters shall be possible.

5.1.2 Maintenance Facilities

(1) Maintenance Equipment and Tools

The Contractor shall maintain the required set of maintenance equipment and tool, and

monitoring and testing software normally required for the maintenance of the electrical and server system. The maintenance equipment and tools shall be maintained in good working condition so that they shall be available all the time. If periodical calibration is required, it shall be calibrated at the regular interval as specified by the supplier of the maintenance equipment. The maintenance staff shall be trained as to the

use of the maintenance equipment and tools. The purchase or depreciation cost of the maintenance equipment and tools shall be deemed to be included in the appropriate cost item in the bid and no separate payment shall be made.

(2) Operation/Maintenance room/space

The Employer will provide the allocated space for operation and maintenance purposes in Command-and-Control Center at both the locations at CTP & MTC to the Contractor. The Contractor shall observe the regulations regarding the use of the maintenance office. Only persons authorized by the Engineer shall be allowed to use the office and the office shall be used solely for the operation & maintenance of the TIMS and CBS. The Contractor shall prepare at his cost desks, chairs, shelves, cabinets, telephone, Internet access, and other furniture and facilities necessary for the efficient operation & maintenance.

(3) Maintenance Office

The Contractor shall prepare and maintain Maintenance Office in Chennai at their own cost. The Contractor shall prepare at his cost all running costs of power and telephone/internet, desks, chairs, shelves, cabinets, and other furniture and facilities necessary for the efficient maintenance operation.

(4) Maintenance Vehicle

The Contractor shall provide a suitable number of vehicles for their operation & maintenance use. The vehicle shall be of the type suitable for maintenance work in terms of the number of staff/ engineers and load-carrying capacity. The vehicle shall meet the relevant government regulations and be managed by the Contractor. The vehicles shall be maintained in good condition to run across the project locations. The vehicle shall clearly indicate a maintenance vehicle on the side of the vehicle and a yellow flashing light shall be provided on the roof of the vehicle. A set of traffic safety devices consisting of safety cones, stand-alone flashing light, and reflective guide and warning signs shall be provided to the maintenance vehicle. The cost of obtaining, operating, and maintaining the maintenance vehicle shall be included in the contract and no separate payment shall be made.

(5) Spare Parts and Consumable

The Contractor shall maintain required spare parts to maintain required service levels. An undertaking to be submitted along with technical bid that the Contractor has the sufficient infrastructure and capability to keep / store spares required for maintenances and will at all times during the contract period maintain sufficient inventory of spares and consumables for operating and maintaining the TIMS and CBS and to meet the Service Level requirements.

The inventory of spare parts shall be maintained during the project period. The mandatory spare parts shall be maintained as specified in Chapter 4 Bill of Quantity and will be audited time to time during the project period and any shortfall in this will be subject to penalty as per one hundred twenty percent (120%) of the unit price quoted in the price bid by the bidder during the project period on quarterly basis. This inventory of mandatory spare parts shall be handed over to the Employer by the Contractor after performance certificate issued by Engineer.

5.2 Preventive Maintenance

The Contractor shall perform the preventive maintenance of all equipment and software supplied under the Contract in accordance with the preventive maintenance schedule to be

developed by the Contractor and approved by the Engineer.

5.2.1 Inspection Item for Preventive Maintenance

The Contractor shall prepare and submit to the Engineer a list of inspection items for all preventive maintenance work under the Contract two (2) months before the expected starting date of the O&M period. The inspection item list shall indicate the type of inspection to be performed daily/weekly, monthly, bi-annually, and annually. The inspection item shall cover all the equipment to be supplied under the Contract.

5.2.2 Schedule for Preventive Maintenance

The Contractor shall prepare and submit to the Employer a schedule for all preventive maintenance work under the Contract two (2) months before the expected starting date of the O&M period.

The schedule shall be in sufficient detail to indicate which part of the monthly inspections is to be performed each week and which part of the bi-annual and annual inspections is to be performed each month and the number of maintenance engineers and technicians to be assigned to the work.

The Contractor will be required to revise the schedule if the workload and the manpower assignment are unbalanced or unrealistic. Failure to submit an acceptable schedule within the specified time shall be asufficient cause for suspension of the Contract and/or withholding of payments due to the Contractor.

5.2.3 Check List

The Contractor shall develop and prepare checklists to be used for preventive maintenance for each type of equipment and software and submit them for the Engineer for his approval. The checklists shall include the type of equipment, equipment ID, serial number, location, date of inspection, name of the inspector, check item, and remarks.

The checklist shall be used every time a periodical inspection of the equipment is made, and the results of the inspection shall be recorded together with other details.

The Contractor is required to submit a copy of all recorded checklists every month and as requested by the Engineer at any time. Failure to maintain or submit the checklists shall be a sufficient cause for suspension of the Contract and/or withholding of payments due to the Contractor.

5.2.4 Software Preventive Maintenance

The Contractor shall perform preventive maintenance of the software to be provided under the Contract as part of the maintenance work. The Contractor shall exert the utmost care not to inadvertently damage the software and database and cause erroneous or abnormal operation of the system.

The items for software maintenance shall include but not be limited to the following:

- Monitoring of CPU, memory, and disk space utilization
- Monitoring of system availability over TCP/IP
- Monitoring of anti-virus and system security software operation
- Backup of the system and restoration of the system when necessary.
- Monitoring and review of system and event logs.

5.2.5 System modification and update

The work to be done consists of modifying the system, system parameter, and other operating conditions and improving the operation or conforming to new operational requirements. The work shall be done as directed by the Engineer. No additional Cost to be paid by the Employer during the project period under this contract.

5.3 Corrective Maintenance and Accident Repair

The Contractor shall provide corrective maintenance and accident repair. Upon reception of a failure/damage notice by the contact person, the Contractor shall log the notice and determine the nature and severity of the failure/damage, prepare the repair plan and dispatch the maintenance crew to the site. Immediate action shall be taken to safeguard the public at any time if the failure

is of nature that causes the hazardous condition.

If the fault cannot be permanently repaired immediately, a temporary repair or remedial measure sufficient to safeguard the operation of the system shall be effected by the Contractor and the Employer shall be so notified. The Contractor shall assess the extent of the damage, prepare the remedial plan.

5.3.1 Resolution Time and Penalty

The purpose of Service Level Requirement (SLR) is to define the required levels of service provided by the Contractor to the Employer for the duration of the contract.

The benefits of this are:

- Help the Employer to control the levels and performance of Contractor services;
- Create clear requirements for measurement of the performance of the system and help in monitoring the same during the Contract duration.
- The Service Levels Requirement are identified according to Service Level Agreement (SLA) between the Employer and the Contractor.

SLA shall become the part of the Contract between the Employer and the Contractor. SLA defines the terms of Contractor responsibility in ensuring the timely delivery of the deliverables and the correctness of the deliverables based on the agreed performance indicators as detailed in this section.

Service level means the service delivery criteria established for the services specified in Service Level Table. The purpose of Service Levels specified in the Service Levels Tables is to clearly define the levels of service which shall be provided by the Contractor to Employer during O&M period i.e. Five Years from the date of go live of CITS System. The service level parameters mentioned in the service level table shall be measured on a quarterly basis as per the individual service level parameter requirements, through appropriate service level measurement tool of Enterprise Management System (EMS) and Network Management System (NMS). Measurement of service levels for systems shall be automatic using reports from appropriate management tool of EMS. Measurement of service levels for services, which are not delivered using a dedicated tool, will be carried out using appropriate and relevant reports from the Service Desk tool.

The Contractor would be penalized for non-compliance in meeting Service Level Requirement (SLR). Any penalty levied by Employer or Employer's representative shall be applicable and deducted from the quarterly payable amount. The Contractor should enable and facilitate continuous measurement of all-round performance of the CITS Project System and not just event-based performance.

The maximum penalty applicable on quarterly applicable payment for not adhering to the SLA's is capped at 25% of the quarterly applicable payment proposed by the Contractor. However, the Employer along with CTP and MTC has an option to consider termination of the contract if the penalty exceeds 20% of the quarterly applicable payment for any two quarters in four consecutive quarters to the Contractor.

The Contractor shall comply with the SLAs to ensure adherence to project timelines, quality and availability of services throughout the duration of the Contract. For the purpose of the SLA, definitions and terms as specified in the document along with the following terms shall have the meanings set forth below:

Measurement of Service Level parameters will be carried out on a cumulative basis in a quarter. The Contractor needs to try to ensure that the service levels as per the service level table. The Contractor needs to submit a service level report in a quarter.

If the performance of the system/services is degraded significantly at any given point in time during the contract and if the immediate measures are not implemented and issues are not rectified to the complete satisfaction of the Employer, then Employer will have the right to take appropriate corrective actions including termination of the Agreement.

The Contractor and Employer shall regularly review the performance of the services being

provided by the Contractor and the effectiveness of this Service Levels. The Contractor is responsible for the development and implementation of appropriate management tools of EMS. Which shall be the basis for all project reviews.

The Exhibit below provides the Service Level Agreement (SLA) to be adhered to by the Contractor during the operational hours of the project/system/sub-system/components. In case of non-adherence of the SLR, the corresponding penalties as defined in the Exhibits below shall apply:

5.3.2 Requirement of Resolution Time from Damaged/Failure situation

In case, System and facility is damaged and failure for operation, Contractor is required to resolve the system and facility as soon as possible. For all cases, the failure shall be classified into three severity levels, Critical, Major and Minor. The Contractor shall satisfy the resolution time specified for each type of failure as presented hereunder.

Figure 5-1: Requirement of resolution time

Severity of Incidents	Definitions	Resolution Time	Falls By	Penalty (INR)	Definition	Calculation
Critical	Incidents which have high possibility of immediately impairing road user's safety. The impact on the monitoring / control of the system and information provision to public will be larger.	<6 hours	2 hours	5,000/	"Resolution time with "Critical severity level " is defined as: time taken to repair the device/equipment/application/ shall be <6 hours and every increase of 2 hours penalty will be calculated	For every Increase of 2 hours in time-to-repair per instance, a penalty of INR. 5,000 shall be imposed.
Major	Incidents which may impair road user's safety. The impact on the monitoring / control of the system and information provision to public is partial.	<12 hours	4 hours	5,000	"Resolution time with "Major severity level " is defined as: time taken to repair the device/equipment/application/ shall be <12 hours and every increase of 4 hours penalty will be calculated	For every Increase of 4 hours in time-to-repair per instance, a penalty of INR. 5,000 shall be imposed.
Minor	Failures of control system that does not have any possibility to impair road users' safety.	<24 hours	8 hours	50,000	"Resolution time with "Minor severity level " is defined as: time taken to repair the device/equipment/application/ shall be <24 hours and every increase of 8 hours penalty will be calculated	For every Increase of 8 hours in time-to-repair per instance, a penalty of INR. 50,000 shall be

	The impact on monitoring					imposed.
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Severity of Incidents	Definitions	Resolution Time	Falls By	Penalty (INR)	Definition	Calculation
	/ control of the system and information provision to public is small in nature.					

1. "Resolution Time" – Time elapsed from the moment incident is reported to the Helpdesk either manually or automatically through system, to the time by which the incident is resolved and services as per the Contract are restored. If complete resolution is not possible in short time, temporally resolution is also considered for recovery from damage and failure.

Category case of Severity

Category case of Severity for each component is shown from Table 5.3 to 5.14 in 5.3.4 Requirement of Availability of each component.

5.3.3 Requirement of Repair Time for bug or accuracy fix

Following incident is not so critical to be solved, but to be improved or repaired shortly within few days.,

Table 5-1: Requirement of Repair time for system bugs and Accuracy fix

No	Component	Repair time	Falls By	Penalty (INR)	Definition	Calculation
1	Application/Software Minor bug fixes	< 7 days	1 day	20,000	"Application/Software Minor bug fixes" is defined as time taken to fix bug so that no effect on normal operations occur	For every increase of 1 day in time to fix the bug per instance, a penalty of INR. 20,000 shall be imposed.
2	Application/Software Major Software bugs - Previous version restoration	< 3day	1 day	50,000	"Application/Software Major Software bugs - Previous version restoration" is defined as restoration of the previous version of the software within 1 calendar day so that application functionality is restored.	For every increase of 1 day in restoring previous version per instance, a penalty of INR. 50,000 shall be imposed.
3	Application/Software Major Software bugs - Release new version	< 30 days	1 day	50,000	"Application/Software Major Software bugs - Release new version" is defined as Release new version of application/software within 30 calendar days with the fix of the major software bug	For every increase of 1 day in version release with bug fix, per instance, a penalty of INR. 50,000 shall be imposed.

4	Data Accuracy Fix	< 7 days	1 day	20,000	"Data Accuracy Fix" is defined as time taken to fix data accuracy as per the functional and technical	For every increase of 1 day in time-to-repair per instance, a penalty of INR.
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No	Component	Repair time	Falls By	Penalty (INR)	Definition	Calculation
					specifications as defined in the bidding documents.	5,000 shall be imposed.

Major bug ; possible to cause a Critical or Major severity situation. Minor bug ; not possible to cause a Critical or Major severity situation.

5.3.4 Requirement of Availability of each component

“Availability “means. When the system is working properly performing all business and functional requirements as defined in this RFP.

The Contractor shall comply with the SLA to ensure adherence to project timelines, quality and availability of services throughout the duration of the Contract. For the purpose of the SLA, definitions and terms as specified in the document along with the following terms shall have the meanings set forth for availability calculation below:

$$\text{Availability (\%)} = [1 - \{(Total\ Downtime) / (Total\ Time - Permissive\ downtime)\}] * 100.$$

- **“Total Time”** – Total number of hours in consideration for evaluation of SLA performance.
- **“Downtime”** – Time period for which the specified services/components/system are not available in the concerned period, being considered for evaluation of SLA
- **“Availability” as Requirement** – Required Time period (%) for which the specified services are available in the period being considered for evaluation of SLA.
- **“Permissive down time”** – It includes the time period required for **Scheduled Maintenance**, repair works for damages caused by the third parties (e.g. traffic accidents, surge caused by thunder storm, fire, vandalism, etc.), Force Majeure, reasons beyond the control of the Contractor and works as instructed by the Employer
- **“Scheduled Maintenance Time”** – Time period for which the specified services/components/system with specified technical and service standards are not available due to scheduled maintenance activity. The scheduled maintenance shall be carried out during non-peak hours and shall not exceed more than six (6) hours and not more than four (4) times in a year
- **“Total Down Time”** – Any event/abnormalities in the service/system being provided that may lead to disruption in regular/normal operations and services to the end user.

The below table covers typical incidents which would act as a guideline. If it is left for the Contractor to decide, they can propose the severities reasonable for severity.

Table 5-2: Availability of ATCS

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
1	ATCS Controller Availability	Critical	99.5%	0.5%	5,000	“Controller Availability” is defined as: (1) device availability, (2) data availability at control center, and (3) proper functioning of the controller and all its related components as per the functional and technical specifications as defined in the bidding documents.	For every decrease of 0.50% in performance of each device, its associated component in a quarter, penalty of INR. 5000 shall be imposed.
2	Detector Availability	Major	99.0%	0.5%	500	“Detector Availability” is defined as device availability and proper functioning of the detector and all its related components as per the functional and technical specifications as defined in the bidding documents.	For every decrease of 0.50% in performance of each device, its associated component in a quarter, penalty of INR. 500 shall be imposed.
3	Signal aspect Availability	Critical	99.0 %	0.5%	100	“Signal aspect Availability” is defined as device availability and proper functioning of the aspect and all its related components as per the functional and technical specifications as defined in the bidding documents.	For every decrease of 0.50% in performance of each device, its associated component in a quarter, penalty of INR. 100 shall be imposed.
4	ATCS Application Availability	Critical	99.5%	0.5%	50,000	"ATCS Application Availability" is defined as the proper functioning of the ATCS Central application and database as per the functional & technical specifications defined in the bidding documents; this shall also include software license validity of any COTS, Database, Software, Anti-virus etc. which is part of the system to achieve operational requirements.	For every decrease of 0.50% in performance for a quarter, a penalty of INR. 50,000 shall be imposed.

Table 5-3: Availability of TIDS

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
1	TIDS Availability	Major	99.0%	0.5%	5,000	“TIDS Availability” is defined as: (1) device availability, (2) data availability at control center, and (3) proper functioning of the controller and all its related components as per the functional and technical specifications as defined in the bidding documents.	For every decrease of 0.50% in performance of each device & its associated component in a quarter, a penalty
2	TIDS Application Availability	Critical	99.5%	0.5%	50,000	"TIDS Application Availability" is defined as the proper functioning of the TIDS Central application and database as per the functional & technical specifications defined in the bidding documents; this shall also include software license validity of any COTS, Database, Software, Anti-virus etc. which is part of the system.	For every decrease of 0.50% in performance for a quarter, a penalty of INR. 50,000 shall be imposed.

Table 5-4: Availability of RLVD

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
1	RLVD Availability	Major	99.0%	0.5%	5,000	“RLVD Availability” is defined as: (1) device availability, (2) data availability at control center, and (3) proper functioning of the RLVD devices and all its related components as per the functional and technical specifications as defined in the bidding documents.	For every decrease of 0.50% in performance of each device & its associated component in a quarter, a penalty of INR. 5000 shall be imposed.
2	RLVD Application Availability	Critical	99.5%	0.5%	50,000	"RLVD Application Availability" is defined as the proper functioning of the RLVD application and database as per the functional & technical specifications defined in the bidding documents;	For every decrease of 0.50% in performance for a quarter, a penalty of INR. 50,000 shall be imposed.

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
						this shall also include software license validity of any COTS, Database, Software, Anti-virus etc. which is part of the system to achieve operational acceptance.	

Table 5-5: Availability of SLVD

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
1	SLVD Availability	Major	99.0%	0.5%	5,000	“SLVD Availability” is defined as: (1) device availability, (2) data availability at control center, and (3) proper functioning of the controller and all its related components as per the functional and technical specifications as defined in the bidding documents.	For every decrease of 0.50% in performance of each device & its associated component in a quarter, a penalty of INR. 5000 shall be imposed.
2	SLVD Application Availability	Critical	99.5%	0.5%	50,000	"SLVD Application Availability" is defined as the proper functioning of the SLVD application and database as per the functional & technical specifications defined in the bidding documents; this shall also include software license validity of any COTS, Database, Software, Anti-virus etc. which is part of the system.	For every decrease of 0.50% in performance for a quarter, a penalty of INR. 50,000 shall be imposed.

Table 5-6: Availability of VMS

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
1	VMS Availability	Major	99.0%	0.5%	5,000	“VMS Availability” is defined as: (1) device availability, (2) data availability at control center, and (3) proper functioning of VMS/controller and all its related components as per the functional and	For every decrease of 0.50% in performance of each device & its associated component in a quarter, a

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
						technical specifications as defined in the bidding documents.	penalty of INR. 5000 shall be imposed.
2	VMS Application Availability	Critical	99.5%	0.5%	50,000	"VMS Application Availability" is defined as the proper functioning of the SLVD application and database as per the functional & technical specifications defined in the bidding documents; this shall also include software license validity of any COTS, Database, Software, Anti-virus etc. which is part of the system.	For every decrease of 0.50% in performance for a quarter, a penalty of INR. 50,000 shall be imposed.

Table 5-7: Availability of ATCC

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
1	ATCC Availability	Major	99.0%	0.5%	5,000	"ATCC Availability" is defined as: (1) device availability, (2) data availability at control center, and (3) proper functioning of the controller and all its related components as per the functional and technical specifications as defined in the bidding documents.	For every decrease of 0.50% in performance of each device & its associated component in a quarter, a penalty of INR. 5000 shall be imposed.
2	ATCC Application Availability	Critical	99.5%	0.5%	50,000	"ATCC Application Availability" is defined as the proper functioning of the ATCC Central application and database as per the functional & technical specifications defined in the bidding documents; this shall also include software license validity of any COTS, Database, Software, Anti-virus etc. which is part of the system.	For every decrease of 0.50% in performance for a quarter, a penalty of INR. 50,000 shall be imposed.

Table 5-8: Availability of ITMS Platform

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
1	Application Availability	Critical	99.5%	0.5%	50,000	"ITMS Application Availability" is defined as the proper functioning of the ITMS Central application and database as per the functional & technical specifications defined in the bidding documents; this shall also include software license validity of any COTS, Database, Software, Anti-virus etc. which is part of the system.	For every decrease of 0.50% in performance for a quarter, a penalty of INR. 50,000 shall be imposed.

Table 5-9: Availability of CAD/AVL

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
1	SCU/BOC Availability	Major	99.0%	0.5%	1,000	"SCU/BDC Availability" is defined as: (1) device availability, (2) data availability at control center, and (3) proper functioning of the SCU/BDC and all its related components as per the functional and technical specifications as defined in the bidding documents.	For every decrease of 0.50% in performance of each device & its associated component in a quarter, a penalty of INR. 1000 shall be imposed.
2	CAD/AVL Application Availability	Critical	99.5%	0.5%	50,000	"CAD/AVL Application Availability" is defined as the proper functioning of the CAD/AVL central application and database as per the functional & technical specifications defined in the bidding documents; this shall also include software license validity of any COTS, Database, Software, Anti-virus etc. which is part of the system.	For every decrease of 0.50% in performance for a quarter, a penalty of INR. 50,000 shall be imposed.

Table 5-10: Availability of PIS

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
1	PIS Availability	Major	99.0%	0.5%	5,000	“PIS Availability” is defined as: (1) device availability, (2) data availability at control center, and (3) proper functioning of the PIS and all its related components as per the functional and technical specifications as defined in the bidding documents.	For every decrease of 0.50% in performance of each device & its associated component in a quarter, a penalty of INR. 5000 shall be imposed.

Table 5-11: Availability of DMS

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
1	DMS Application Availability	Critical	99.5%	0.5%	1,000	"DMS Application Availability" is defined as the proper functioning of the DMS application and database as per the functional & technical specifications defined in the bidding documents; this shall also include software license validity of any COTS, Database, Software, Anti-virus etc. which is part of the system.	For every decrease of 0.50% in performance for a quarter, a penalty of INR. 50,000 shall be imposed.

Table 5-12: Availability of Communications Network

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
1	Communication (Wired Connectivity) Availability	Critical	99.5%	0.25%	10,000	"Communications (wired connectivity)" is defined as the uptime of connectivity between all device locations and Control Center.	For every decrease of 0.25% in performance of each device/location & its associated component in a quarter, a penalty of INR. 10,000 shall be imposed

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
2	Communication (Wireless Connectivity-SIM Card) Availability	Critical	99.5%	0.5%	200	"Communications (wireless connectivity)" is defined as the uptime of connectivity between all device locations and buses to application accessibility at Control Center.	For every decrease of 0.50% in performance of each device/location & its associated component in a quarter, a penalty of INR. 200 shall be imposed

Table 5-13: Availability of Command Control Centre

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
1	Video wall Display Availability	Major	95.0%	0.5%	2,000	“ Video wall Display Availability” is defined as display panel availability and proper functioning of the display and all its related components as per the functional and technical specifications as defined in the bidding documents.	For every decrease of 1% in performance of individual display panel and its associated component in a quarter, a penalty of INR. 2,000 shall be imposed.
2	Server / Storage / Tape drive/ Router/ Load Balancer, etc. Availability	Critical	99.99%	0.10%	50,000	"Server / Storage / Tape drive/ Router/ Load Balancer, etc. Availability” is defined as: a device/ equipment is working properly with all its features & functions along with required hardware & software as defined in the bidding documents	For every decrease of 0.10% in performance of each device & its associated component in a quarter, a penalty of INR. 50,000 shall be imposed
3	Firewall Availability	Critical	99.99 %	0.10%	50,000	"Firewall Availability” is defined as: Firewall is available and working properly with all its features & functions along with required hardware & software as defined in the bidding documents	For every decrease of 0.10% in performance of each device & its associated component in a quarter, a penalty of INR. 50,000 shall be imposed
4	Workstations/ Printer Availability	Moderate	99.5%	0.5%	2,000	"Workstations/ Printer Availability” is defined as: Workstations/ Printer is available and working properly with all its features & functions along with required hardware & software as defined in the bidding documents	For every decrease of 0.50% in performance of each device & its associated component in a quarter, a penalty of INR. 2,000 shall be imposed

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
5	Local area network within CCC	Critical	99.50%	0.25%	2,000	"Local area network within CCC" is defined as: device/ equipments at Depots, Terminals & Command and Control Center shall be available (up & running) as per the requirements defined in the bidding documents. The availability will be calculated based on each individual subarea level.	For every decrease of 0.25% in Local Network availability for each location in a period of one month, a penalty of INR. 2,000 shall be imposed
6	UPS with 3 hours battery backup at all locations (data center, field, etc.)	Critical	99.5%	0.50%	5,000	"UPS Availability" is defined as: UPS running in "Bypass" mode shall also be considered as unavailability.	For every decrease of 0.50% in performance of each device & its associated component in a quarter, a penalty of INR. 5,000 shall be imposed. Availability shall be calculated only for power outages that are less than the UPS backup time. Power outages beyond UPS backup time shall be excluded from the SLA calculations.
7	Other application Availability (Web Portal/ Mobile App/ Any other application, Integration services, etc.)	Critical	99.50%	0.50%	50,000	"Other Application Availability" is defined as the proper functioning of the all other application and database as per the functional & technical specifications defined in the bidding documents; this shall also include software license validity of any COTS, Database, Software, API, Anti-virus etc. which is part of the system.	For every decrease of 0.50% in performance for a quarter, a penalty of INR. 50,000 shall be imposed.
8	SMS services	Major	99.00%	0.50%	5,000	"SMS service" is defined as the proper functioning of SMS service and database as per the functional & technical specifications defined in the bidding documents; this shall also include software license validity of Database, API, Software, Anti-virus etc. which is part of the system.	For every decrease of 0.50% in performance for a quarter, a penalty of INR. 50,000 shall be imposed.

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
9	EMS & NMS application Availability	Major	99.50%	0.50%	50,000	"EMS & NMS Application Availability" is defined as the proper functioning of the EMS & NMS application and database as per the functional & technical specifications defined in the bidding documents; this shall also include software license validity of any COTS, Database, Software, Anti-virus etc. which is part of the system.	For every decrease of 0.50% in performance for a quarter, a penalty of INR. 50,000 shall be imposed.

5.3.5 Requirement of Performance/Accuracy of the component

Sample inspection on Accuracy count to compare count by manual count by video, by handy detector or etc.

Table 5-14: Performance/Accuracy of ATCS

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
1	ATCS Counting Accuracy	Minor	92.0%	0.5%	1,000	"Counting Accuracy" is defined as: Percentage of vehicles counted at control center to the vehicles counted in the field.	For every decrease of 0.50% in performance for a quarter, a penalty of INR. 1000 shall be imposed. Measurement to be made at different time of the day for random time periods set by Employer, every quarter.

Table 5-15: Performance/Accuracy of TIDS

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
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1	TIDS Data accuracy	Minor	95.0%	0.5%	2,000	"TIDS Data Accuracy" is defined as: Percentage of incidents counted at control center to the incidents counted in the field.	For every decrease of 0.50% in performance for a quarter, a penalty of INR. 2000 shall be imposed. Measurement to be made at different time of the day for random time periods set by Employer, every quarter.
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Table 5-16: Performance/Accuracy of RLVD

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
1	RLVD Data accuracy	Minor	95.0%	0.5%	2,000	"RLVD Data Accuracy" is defined as: Percentage of violations counted at control center to the violations counted in the field.	For every decrease of 0.50% in performance for a quarter, a penalty of INR. 2000 shall be imposed. Measurement to be made at different time of the day for random time periods set by Employer, every quarter.
2	ANPR for standard number plates accuracy	Minor	75.00%	0.50%	10,000	ANPR for standard number plates Accuracy" is defined as: The detection accuracy of a ANPR system is measured against the correct license plates been read by the system. Any standard license plate not correctly read by ANPR system shall be considered as unreadable and specified penalty is applicable as per the above parameters.	For every decrease of 0.50% in performance for a quarter, a penalty of INR. 10,000 shall be imposed.
3	Generation of violation tickets	Minor	99.50 %	0.50%	1,000	"Generation of violation tickets" is defined as: Generation of E-challan/ Violation tickets to violators automatically from the application.	For every decrease of 0.50% in performance for a quarter, a penalty of INR. 1000 shall be imposed.

Table 5-17: Performance/Accuracy of SLVD

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
1	SLVD Data accuracy	Minor	95.0%	0.5%	2,000	"SLVD Data Accuracy" is defined as: Percentage of violations counted at control center to the violations counted in the field. Sample inspection on SLVD Counting Accuracy to compare count by Handy Speed Detector	For every decrease of 0.50% in performance for a quarter, a penalty of INR. 2000 shall be imposed. Measurement to be made at different time of the day for random time periods set by Employer, every quarter.

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
2	ANPR for standard number plates accuracy	Minor	75.00%	0.50%	10,000	ANPR for standard number plates Accuracy” is defined as: The detection accuracy of a ANPR system is measured against the correct license plates been read by the system. Any standard license plate not correctly read by ANPR system shall be considered as unreadable and specified penalty is applicable as per the above parameters.	For every decrease of 0.50% in performance for a quarter, a penalty of INR. 10,000 shall be imposed.
3	Generation of violation tickets	Minor	99.50 %	0.50%	1,000	"Generation of violation tickets” is defined as: Generation of E-challan/ Violation tickets to violators automatically from the application.	For every decrease of 0.50% in performance for a quarter, a penalty of INR. 1000 shall be imposed.

Table 5-18: Performance/Accuracy of ATCC

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
1	ATCC Counting accuracy	Minor	92.0%	1.0%	5,000	"Counting Accuracy” is defined as: Percentage of vehicles counted at control center to the vehicles counted in the field.	For every decrease of 1% in performance for a quarter, a penalty of INR. 5000 shall be imposed. Measurement to be made at different time of the day for random time periods set by Employer, every quarter.
2	Classification Accuracy	Minor	75.00%	5.00%	5,000	"Classification Accuracy” is defined as: Weighted percentage of vehicles classified at control center to the vehicles classified in the field.	For every decrease of 1% in performance for a quarter, a penalty of INR. 5000 shall be imposed. Measurement to be made at different time of the day for random time periods set by Employer, every quarter.

Table 5-19: Performance of ETA Accuracy

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
1	Predictions for ETA made 15 minutes before the bus arrival shall have accuracy between -2 to 7 minutes	Minor	70.00	0.5%	5,000	ETA Accuracy” is calculated at all bus shelters/terminals for the buses as the difference between the expected and actual arrival times. This should be within -2 to 7 minutes, predicted 15 minutes before the actual measured arrival time	For every decrease of 0.50% in performance for a quarter, a penalty of INR. 5000 shall be imposed.

Table 5-20: Application Performance

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
1	Data Loading in 3 seconds for all applications/software	Minor	99.5%	0.5%	2,000	"Data Loading Time" is defined as the time elapsed between sending request from client to server and receiving the response.	For every decrease of 0.50% in performance for a quarter, a penalty of INR. 2,000 shall be imposed. Applies to all project applications.
2	Report Loading in 5 seconds for all applications/software	Minor	99.5%	0.5%	2,000	"Report Loading Time" is defined as the time elapsed between sending request from client to server and receiving the response for loading a report.	For every decrease of 0.50% in performance for a quarter, a penalty of INR. 2,000 shall be imposed. Applies to all project applications.

Table 5-21: Security Requirement Performance

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
1	Security Reporting	Minor	Quarterly security report to be submitted with 100% KPIs defined for security	100%	5,000	"Security report" is defined as: Generation of security report for systems/subsystems as per defined KPI during the quarter.	For every delay of one day a penalty of INR. 5,000/ day shall be imposed

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
2	Vulnerability assessment and closure	Minor	Quarterly security report for all systems/ subsystems to be submitted within 1st week of each quarter. All detected vulnerabilities to be closed within 7 days of security report generation. Employer may appoint third party agency to cross-check".	100%	20,000	"Vulnerability assessment and closure" is defined as: vulnerability found in the assessment report shall be fixed and same may be verified by third party auditor appointed by Employer.	For every delay of one day after 7 days a penalty of INR. 20,000 /day shall be imposed
3	Penetration testing	Minor	Penetration testing shall be conducted once in every quarter. All vulnerabilities shall be closed within 7 days.	100%	2,000	"Penetration testing" is defined as: vulnerability found in the testing shall be fixed and same may be verified by third party auditor appointed by Employer.	For every delay of one day after 7 days a penalty of INR. 2,000/day shall be imposed
4	Application Security	Minor	Cyber Crime/ Hacking/ Data Theft/ Fraud attributable to the Contractor to be evaluated per occurrence.	100%	2,000	"Application security" is defined as: Cyber Crime/ Hacking/ Data Theft/ Fraud attributable on the system will be evaluated per occurrence. vulnerability found in the testing shall be fixed and same may be verified by third party auditor appointed by Employer.	For every delay of one day after 7 days a penalty of INR. 2,000/day shall be imposed

Table 5-22: Helpdesk Performance

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
1	Helpdesk application Availability	Major	99.50%	0.50%	2,500	"Helpdesk application Availability" is defined as the proper functioning of the Helpdesk application and database as per the functional & technical specifications defined in the bidding documents; this shall also include software license validity of any COTS, Database, Software, Anti-virus etc. which is part of the system.	For every decrease of 0.50% in performance for a quarter, a penalty of INR. 2,500 shall be imposed.

No	Component	Severity Level	Requirement	Falls By percent	Penalty (INR)	Definition	Calculation
2	Helpdesk logging of service tickets	Minor	99.50%	0.50%%	2,500	"Helpdesk logging of service tickets" is defined as the proper functioning of the Helpdesk logging of service tickets automatically and manually by the operator/Employer on the ticketing tool..	For every decrease of 0.50% in logging of service ticket number calculated over a period of one quarter, a penalty of INR. 2,500 shall be imposed

5.3.6 Reporting Procedures

The Contractor representative shall prepare and distribute SLA Monitoring Report in a mutually agreed format Quarterly. The reports shall include “actual versus target” Service Level Performance, variance analysis, and discussion of appropriate issues or significant events. Performance reports shall be distributed to the Employer management personnel as directed by the Employer.

Also, the Contractor may be required to get the SLA Monitoring Report audited by a third-party Auditor appointed by the Employer.

5.3.7 Service Level Change Control

It is acknowledged that this Service Levels may change as the Employer’s business needs evolve over the course of the contract period. As such, this document also defines the following management procedures:

- A process for negotiating changes to the Service Levels.
- An issue management process for documenting and resolving particularly difficult issues.
- the Employer and Contractor management escalation process to be used if an issue is not being resolved in a timely manner by the lowest possible level of management.

Any changes to the levels of service provided during the term of this Agreement shall be requested, documented, and negotiated in good faith by both Parties. Either party can request a change.

(1) Service Level Change Process:

The Parties may amend Service Level by mutual agreement in accordance. Changes can be proposed by either Party. Unresolved issues shall also be addressed. Contractor’s representative shall maintain and distribute current copies of the Service Level document as directed by the Employer. Additional copies of the current Service Levels shall always be available to authorized Parties.

(2) Version Control / Release Management:

All negotiated changes shall require changing the version control number. As appropriate, minor changes may be accumulated for periodic release or for release when a critical threshold of change has occurred.

(3) Service Levels Review Process:

- Either Employer or Contractor may raise an issue by documenting the business or technical problem, which presents a reasonably objective summary of both points of view and identifies specific points of disagreement with possible solutions.
- A meeting or conference call will be conducted to resolve the issue in a timely manner. The documented issues will be distributed to the participants at least 24 hours prior to the discussion if the issue is not an emergency requiring immediate attention.
- The Employer and the Contractor shall develop an interim solution, if required, and subsequently the permanent solution for the problem at hand. The Contractor will then communicate the resolution to all interested parties.
- In case the issue is still unresolved, the arbitration procedures described in Clause 20 of Conditions of Contract will be applicable.

(Bid Covering Letter / Annexure-A)

To
ITI Limited, MSP-
Delhi
Core-1 Floor-11
Scope Minar
Laxmi Nagar
New Delhi-92

**Subject: Bid Covering Letter against Expression of Interest (EoI) for
Design, Supply, Installation, Commissioning, Operations and
Maintenance of Intelligent Transportation Systems in a metropolitan**

Ref: Tender no. dated

Dear Sir,

Having examined the EoI/RFP/Tender document, we hereby submit our bid for the subject requirement which has emerged from some Government body to implement the above captioned project.

We confirm that the information contained in this response or any part thereof, including its exhibits, and other documents and instruments delivered or to be delivered to ITI Limited is true, accurate, verifiable and complete. This response includes all information necessary to ensure that the statements therein do not in whole or in part mislead the Buyer in its short-listing process.

We fully understand and agree to comply that on verification, if any of the information provided here is found to be misleading the short-listing process, we are liable to be dismissed from the selection process or termination of the agreement during the project, if selected to do so.

We agree for unconditional acceptance of all the terms and conditions set out in the EoI/RFP/Tender document including annexures and corrigendum if any and also agree to abide by this tender response for a period of 6 months from the date fixed for bid opening.

We hereby declare that in case the agreement is awarded to us, we shall submit the Performance Guarantee in the form of bank guarantee in the format to be provided by ITI Limited.

We agree that ITI Limited is not bound to accept any tender response that they may receive. We also agree that ITI Limited reserves the right in absolute sense to reject all or any of the services specified in the tender response.

It is hereby confirmed that I/We are entitled to act on behalf of our company/ corporation/ firm/ organization and empowered to sign this document as well as such other documents, which may be required in this connection.

We understand that it will be the responsibility of our organization to keep ITI Limited informed of any changes in respect of authorized person and we fully understand that ITI Limited shall not be responsible for non-receipt or non-delivery of any communication and/or any missing communication in the event reasonable prior notice of any change in the authorized person of the company is not provided to ITI Limited.

Dated this Day of **2021**

Authorized Signatory

Name:

Designation:

(Company Seal)

Note: To be submitted in Company Letterhead

Bidder's Profile

1.	Name and address of the company			
2.	Contact Details of the Bidder (Contact person name with Designation, Telephone Number, FAX, E- mail and Web site)			
3.	Area of Business			
4.	Annual Turnover in last 3 financial years (Rs in Crore)	2018-19	2019-20	2020-21
5.	IT Turnover in last 3 financial years (Rs in Crore)	2018-19	2019-20	2020-21
6.	Profit / Loss in last 3 financial years (Rs in Crore)	2018-19	2019-20	2020-21
7.	Net-worth in last 3 financial years (Rs in Crore)	2018-19	2019-20	2020-21
8.	Date of Incorporation			
9.	GST Registration number			
10.	PAN Number			
11.	CIN Number, if applicable			
12.	Number of technical manpower in company's rolls			

Dated this Day of **2021**

Authorized Signatory

Name:

Designation:

(Company Seal)

Note: To be submitted in Company Letterhead

To
ITI Limited, MSP-
Delhi
Rohit House, 3
Tolstoy Marg New
Delhi- 110001

Subject: Undertaking towards Non-Black Listing of our firm by any Govt. Body

Dear Sir,

We hereby declare that we have not been BLACK LISTED by any Govt. department/ PSU (State or Central)/ Autonomous Institution against our performance obligation in India and there has been no litigation with any government department on account of similar services for the last 5 years.

This declaration is being submitted as per the requirement of your EoI/RFP/Tender.

Dated this Day of **2021**

Authorized Signatory

Name:

Designation:

(Company Seal)

Note: To be submitted in+ Company Letterhead

(Declarations / Annexure-D)

To
ITI Limited, MSP-
Delhi
Rohit House, 3
Tolstoy Marg New
Delhi- 110001

Subject: Declarations against Expression of Interest (EoI) for Design, Supply, Installation, Commissioning, Operations and Maintenance of Intelligent Transportation Systems in a metropolitan city

Tender no. dated

Dear Sir,

We hereby declare / undertake the following.

We hereby declare that we will work with ITI as per EOI/RFP/Tender terms and conditions of ITI as well as end customer including warranty & post-warranty services and implementation of the project in the event of ITI winning the contract on back-to-back basis.

We hereby declare that we will submit the Tender Fee & EMD (while submitting the bid to the end customer in the form of Bank Guarantee / Demand Draft / Online Payment from any Nationalized / Scheduled Bank) & Performance Bank Guarantee to end customer or ITI (as decided by ITI) as per EoI/RFP/Tender terms & conditions. We also undertake that we will provide EMD & PBG to ITI as per the end-customer's EoI/RFP/Tender terms even if ITI is exempted to submit the same to end- customer because of its PSU status.

We hereby declare that we have 'No Objection/ No Claim/ No Compensation' from ITI Limited if this EoI/RFP/Tender is cancelled at any stage of evaluation process by ITI or the main EoI/RFP/Tender is cancelled by the end customer.

We hereby undertake that we will be equipped with the required manpower with qualifications, certifications and experience as required in the end customer's EoI/RFP/Tender.

We hereby undertake that we will be able to give the proposed solution as required in the end customer's EoI/RFP/Tender.

We hereby undertake that we will arrange required certificate & support (warranty & post-warranty/maintenance) in the name of ITI Limited from the OEM as per end customer's requirement.

We hereby undertake that we will obtain relevant statutory licenses for operational activities.

We hereby undertake that we will sign Consortium Agreement /Teaming Agreement / Integrity Pact with ITI for addressing the end customer's EoI/RFP/Tender if required.

We indemnify ITI Limited from any claims / penalties / statutory charges / liquidated damages / legal expenses if any etc. as charged by the end customer.

We hereby undertake to make arrangement for signing of agreement between OEM and ITI as per end customer's EoI/RFP/Tender requirements.

We hereby undertake that the OEMs who meet the eligibility and other conditions as per end customer's EoI/RFP/Tender requirement will be finalized by us and produce the required eligibility documents and other related documents of the OEM for final bid submission.

We hereby agree to take the responsibilities covered in the agreement (on back-to-back basis) to be signed between ITI & OEM (if required) as per end customer's EoI/RFP/Tender terms&conditions.

We hereby declare to supply equipment/components which are brand new, first hand and contain no previously used, recycled or refurbished components.

We hereby declare not to partner with any other organization for addressing this EoI/RFP/Tender.

We hereby declare to accept payment terms on back-to-back basis. Penalties, if any, will be borne by us.

We hereby declare to provide Bank Guarantee (110% of value for the period till the advance is settled) for getting the advance payment if any on back-to-back basis.

We hereby agree that ITI may take any punitive action as deemed fit, including forfeiture of EMD / Security submitted by us, if it is found that any of the documents / information provided by us (to meet the tender requirement including eligibility) is wrong/ forged/ misleading at any stage of tender processing / evaluation. The decision of ITI regarding forfeiture of the EMD shall be final and shall not be called upon question under any circumstances

Dated this Day of **2021**

Authorized Signatory

Name:

Designation:

(Company Seal)

Note: To be submitted in Company Letterhead

Compliance Statement of Eligibility Criteria

Ref: Tender no. dated

Sl. No.	Clause No.	Clause	Compliance (Complied/Not Complied)	Remarks with Documentary Reference

Dated this Day of **2021**Authorized Signatory

Name:

Designation:

(Company Seal)

INTEGRITY PACT

PURCHASE ORDER No.

THIS Integrity Pact is made on.....day of..... 21 .

BETWEEN:

ITI Limited having its Registered & Corporate Office at ITI Bhavan, Dooravaninagar, Bangalore – 560 016 and established under the Ministry of Communications, Government of India (hereinafter called the Principal), which term shall unless excluded by or is repugnant to the context, be deemed to include its Chairman & Managing Director, Directors, Officers or any of them specified by the Chairman & Managing Director in this behalf and shall also include its successors and assigns) ON THE ONE PART

AND:

..... represented by Chief Executive Officer (hereinafter called the Contractor(s), which term shall unless excluded by or is repugnant to the context be deemed to include its heirs, representatives, successors and assigns of the contractor ON THE SECOND PART.

Preamble

WHEREAS the Principal intends to award, under laid down organizational procedures, contract for of ITI Limited. The Principal, values full compliance with all relevant laws of the land, regulations, economic use of resources and of fairness/ transparency in its relations with its Contractor(s).

In order to achieve these goals, the Principal has appointed an Independent External Monitor (IEM), who will **monitor** the tender process and the execution of the contract for compliance with the principles as mentioned herein this agreement.

WHEREAS, to meet the purpose aforesaid, both the parties have agreed to enter into this Integrity Pact the terms and conditions of which shall also be read as integral part and parcel of the Tender Documents and contract between the parties.

NOW THEREFORE, IN CONSIDERATION OF MUTUAL COVENANTS STIPULATED IN THIS PACT THE PARTIES HEREBY AGREE AS FOLLOWS AND THIS PACT WITNESSETH AS UNDER:

SECTION 1 – COMMITMENTS OF THE PRINCIPAL

- 1.1 The Principal commits itself to take all measures necessary to prevent corruption and to observe the following principles:
- a. No employee of the Principal, personally or through family members, will in connection with the tender for or the execution of the contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.
 - b. The Principal will, during the tender process treat all bidder(s) with equity and reason. The Principal will in particular, before and during the tender process, provide to all bidder(s) the same information and will not provide to any bidder(s) confidential/additional information through which the bidder(s) could obtain an advantage in relation to the tender process or the contract execution.
 - c. The Principal will exclude from the process all known prejudiced persons.
- 1.2 If the Principal obtains information on the conduct of any of its employee, which is a criminal offence under IPC/PC Act or if there be a substantive suspicion in this regard, the Principal will inform the Chief Vigilance Officer and in addition can initiate disciplinary action as per its internal laid down Rules/ Regulations.

SECTION 2 – COMMITMENTS OF THE BIDDER/CONTRACTOR

- 2.1 The Contractor(s) commits himself to take all measures necessary to prevent corruption. He commits himself observe the following principles during the participation in the tender process and during the execution of the contract.
- a. The contractor(s) will not, directly or through any other person or firm offer, promise or give to any of the Principal's employees involved in the tender process or the execution of the contract or to any third person any material or other benefit which he/she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the tender process or during the execution of the contract.
 - b. The contractor(s) will not enter with other contractors into any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process.
 - c. The contractor(s) will not commit any offence under IPC/PC Act, further the contractor(s) will not use improperly, for purposes of competition of personal

gain, or pass onto others, any information or document provided by the Principal as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.

- d. The Contractor(s) of foreign origin shall disclose the name and address of the agents/representatives in India, if any. Similarly, the Bidder(s)/Contractor(s) of Indian Nationality shall furnish the name and address of the foreign principals, if any.
- e. The Contractor(s) will, when presenting the bid, disclose any and all payments made, are committed to or intend to make to agents, brokers or any other intermediaries in connection with the award of the contract.
- f. The Contractor(s) will not bring any outside influence and Govt bodies directly or indirectly on the bidding process in furtherance to his bid.
- g. The Contractor(s) will not instigate third persons to commit offences outlined above or to be an accessory to such offences.

SECTION 3 – DISQUALIFICATION FROM TENDER PROCESS & EXCLUSION FROM FUTURE CONTRACTS

- 3.1 If the Contractor(s), during tender process or before the award of the contract or during execution has committed a transgression in violation of Section 2, above or in any other form such as to put his reliability or credibility in question the Principal is entitled to disqualify Contractor(s) from the tender process.
- 3.2 If the Contractor(s), has committed a transgression through a violation of Section 2 of the above, such as to put his reliability or credibility into question, the Principal shall be entitled exclude including blacklisting for future contract award process. The imposition and duration of the exclusion will be determined by the severity of the transgression. The severity will be determined by the Principal taking into consideration the full facts and circumstances of each case, particularly taking into account the number of transgression, the position of the transgressor within the company hierarchy of the Contractor(s) and the amount of the damage. The exclusion will be imposed for a period of minimum one year.
- 3.3 The Contractor(s) with its free consent and without any influence agrees and undertakes to respect and uphold the Principal's absolute right to resort to and impose such exclusion and further accepts and undertakes not to challenge or question such exclusion on any ground including the lack of any hearing before the decision to resort to such exclusion is taken. The undertaking is given freely and after obtaining independent legal advice.

- 3.4 A transgression is considered to have occurred if the Principal after due consideration of the available evidence concludes that on the basis of facts available there are no material doubts.
- 3.5 The decision of the Principal to the effect that breach of the provisions of this Integrity Pact has been committed by the Bidder(s)/ Contractor(s) shall be final and binding on the Bidder(s)/ Contractor(s), however the Bidder(s)/ Contractor(s) can approach IEM(s) appointed for the purpose of this Pact.
- 3.6 On occurrence of any sanctions/ disqualifications etc arising out from violation of integrity pact Bidder(s)/ Contractor(s) shall not entitled for any compensation on this account.
- 3.7 subject to full satisfaction of the Principal, the exclusion of the Contractor(s) could be revoked by the Principal if the Contractor(s) can prove that he has restored/ recouped the damage caused by him and has installed a suitable corruption preventative system in his organization.

SECTION 4 – PREVIOUS TRANSGRESSION

- 4.1 The Contractor(s) declares that no previous transgression occurred in the last 3 years immediately before signing of this Integrity Pact with any other company in any country conforming to the anti-corruption/ transparency International (TI) approach or with any other Public Sector Enterprises/ Undertaking in India of any Government Department in India that could justify his exclusion from the tender process.
- 4.2 If the Contractor(s) makes incorrect statement on this subject, he can be disqualified from the tender process or action for his exclusion can be taken as mentioned under Section-3 of the above for transgressions of Section-2 of the above and shall be liable for compensation for damages as per Section- 5 of this Pact.

SECTION 5 – COMPENSATION FOR DAMAGE

- 5.1 If the Principal has disqualified the Bidder(s)/Contractor(s) from the tender process prior to the award according to Section 3 the Principal is entitled to forfeit the Earnest Money Deposit/Bid Security/ or demand and recover the damages equitant to Earnest Money Deposit/Bid Security apart from any other legal that may have accrued to the Principal.
- 5.2 In addition to 5.1 above the Principal shall be entitled to take recourse to the relevant provision of the contract related to termination of Contract due to Contractor default. In such case, the Principal shall be entitled to forfeit the Performance Bank Guarantee of the Contractor or demand and recover liquidate and all damages as per the provisions of the contract agreement against termination.

SECTION 6 – EQUAL TREATMENT OF ALL BIDDERS/CONTRACTORS

- 6.1 The Principal will enter into Integrity Pact on all identical terms with all bidders and contractors for identical cases.
- 6.2 The Bidder(s)/Contractor(s) undertakes to get this Pact signed by its sub- contractor(s)/sub-vendor(s)/associate(s), if any, and to submit the same to the Principal along with the tender document/contract before signing the contract. The Bidder(s)/Contractor(s) shall be responsible for any violation(s) of the provisions laid down in the Integrity Pact Agreement by any of its sub-contractors/sub- vendors/associates.
- 6.3 The Principal will disqualify from the tender process all bidders who do not sign this Integrity Pact or violate its provisions.

SECTION 7 – CRIMINAL CHARGES AGAINST VIOLATING BIDDER(S)/ CONTRACTOR(S)

- 7.1 If the Principal receives any information of conduct of a Contractor(s) or sub- contractor/sub-vendor/associates of the Contractor(s) which constitutes corruption or if the Principal has substantive suspicion in this regard, the Principal will inform the same to the Chief Vigilance Officer of the Principal for appropriate action.

SECTION 8 – INDEPENDENT EXTERNAL MONITOR(S)

- 8.1 The Principal appoints competent and credible Independent External Monitor(s) for this Pact. The task of the Monitor is to review independently and objectively, whether and to what extent the parties comply with the obligations under this pact.
- 8.2 The Monitor is not subject to any instructions by the representatives of the parties and performs his functions neutrally and independently. He will report to the Chairman and Managing Director of the Principal.
- 8.3 The Contractor(s) accepts that the Monitor has the right to access without restriction to all product documentation of the Principal including that provided by the Contractor(s). The Bidder(s)/Contractor(s) will also grant the Monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his project documentation. The Monitor is under contractual obligation to treat the information and documents Contractor(s) with confidentiality.
- 8.4 The Principal will provide to the Monitor sufficient information about all meetings among the parties related to the project provided such meeting could have an impact on the contractual relations between the Principal and the Contractor(s). As soon as the Monitor notices, or believes to notice, a violation of this agreement, he will so inform the Management of the Principal and request the Management to discontinue or take corrective action, or to take other relevant action. The monitor can in this regard submit non-binding recommendations. Beyond this, the Monitor has no right to demand from the parties that they act in specific manner, refrain from action or tolerate action.

- 8.5 The Monitor will submit a written report to the Chairman & Managing Director of the Principal within a reasonable time from the date of reference or intimation to him by the principal and, should the occasion arise, submit proposals for correcting problematic situations.
- 8.6 If the Monitor has reported to the Chairman & Managing Director of the Principal a substantiated suspicion of an offence under relevant IPC/PC Act, and the Chairman & Managing Director of the Principal has not, within the reasonable time taken visible action to proceed against such offence or reported it to the Chief Vigilance Officer, the Monitor may also transmit this information directly to the Central Vigilance Commissioner.
- 8.7 The word '**Monitor**' would include both singular and plural.

Any changes to the same as required / desired by statutory authorities is applicable.

SECTION 9 – FACILITATION OF INVESTIGATION

- 9.1 In case of any allegation of violation of any provisions of this Pact or payment of commission, the Principal or its agencies shall be entitled to examine all the documents including the Books of Accounts of the Bidder(s)/Contractor(s) and the Bidder(s)/Contractor(s) shall provide necessary information and documents in English and shall extend all help to the Principal for the purpose of verification of the documents.

SECTION 10 – LAW AND JURISDICTION

- 10.1 The Pact is subject to the Law as applicable in Indian Territory. The place of performance and jurisdiction shall be the seat of the Principal.
- 10.2 The actions stipulated in this Pact are without prejudice to any other legal action that may follow in accordance with the provisions of the extant law in force relating to any civil or criminal proceedings.

SECTION 11 – PACT DURATION

- 11.1 This Pact begins when both the parties have legally signed it. It expires after 12 months on completion of the warranty/guarantee period of the project / work awarded, to the fullest satisfaction of the Principal.
- 11.2 If the Contractor(s) is unsuccessful, the Pact will automatically become invalid after three months on evidence of failure on the part of the Contractor(s).
- 11.3 If any claim is lodged/made during the validity of the Pact, the same shall be binding and continue to be valid despite the lapse of the Pact unless it is discharged/determined by the Chairman and Managing Director of the Principal.

SECTION 12 – OTHER PROVISIONS

- 12.1 This pact is subject to Indian Law, place of performance and jurisdiction is the Registered & Corporate Office of the Principal at Bengaluru.
- 12.2 Changes and supplements as well as termination notices need to be made in writing by both the parties. Side agreements have not been made.
- 12.3 If the Contractor(s) or a partnership, the pact must be signed by all consortium members and partners.
- 12.4 Should one or several provisions of this pact turn out to be invalid, the remainder of this pact remains valid. In this case, the parties will strive to come to an agreement to their original intentions.
- 12.5 Any disputes/ difference arising between the parties with regard to term of this Pact, any action taken by the Principal in accordance with this Pact or interpretation thereof shall not be subject to any Arbitration.
- 12.5 The action stipulates in this Integrity Pact are without prejudice to any other legal action that may follow in accordance with the provisions of the extant law in force relating to any civil or criminal proceedings.

In witness whereof the parties have signed and executed this Pact at the place and date first done mentioned in the presence of the witnesses:

For PRINCIPAL

For CONTRACTOR(S)

.....
(Name & Designation)

.....
(Name & Designation)

Witness

Witness

1)1).....

2) 2).....