

**REQUEST FOR PROPOSAL
FOR
SELECTION OF SYSTEM INTEGRATOR FOR IMPLEMENTATION
OF
PAN-CITY ICT COMPONENTS FOR WARANGAL SMART CITY**

VOLUME-II: SCOPE OF WORK WITH FRS/TRS

RFP No.: 3/SI/GWSCCL/2017

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**GOVERNMENT OF TELANGANA
GREATER WARANGAL SMART CITY
CORPORATION LTD**

**PMC Consultants
LEA Associates South Asia Pvt. Ltd
in Consortium with
PricewaterhouseCoopers Pvt. Ltd.**



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Glossary

<i>Terms</i>	<i>Meaning</i>
GWSCCL	Warangal Smart City Corporation Limited
RFP	Request for Proposal
CCTV	Closed Circuit Television
BOM	Bill of Material
GIS	Geographical Information Systems
GPS	Global Positioning System
ICT	Information and Communication Technology
OEM	Original Equipment Manufacture
MSI	Master System Integrator
SOP	Standard Operating Procedures
UAT	User Acceptance Testing
VM	Virtual Machine
ICCC	Integrated Command and Control Centre
ITMS	Intelligent Traffic Management System
ATCS	Area Traffic Control System
MMTS	Multi-Modal Transport Systems
ECB	Emergency Call Box
DC	Data Centre
IT	Information Technology
IP	Internet Protocol
AMC	Annual Maintenance Contract
OFC	Optical Fiber Cable
PA	Public Address
ANPR	Automatic Number Plate Recognition
RLVD	Red Light Violation Detection
SVD	Speed Violation Detection
PTZ	Pan Tilt Zoom
PoP	Point of Presence
TPA	Third Party Auditor
FMS	Facility Management Services
UPS	Uninterrupted Power Supply
VMS	Variable Message Sign
GSM	Global System for Mobile Communication

1 Introduction

1.1 Project Background

One of the primary objective of Warangal under its smart city mission is to enhance the safety and security, improve efficiency of municipal services and promote a better quality of life for residents. In order to achieve these objectives, Warangal desires to foster the development of a robust ICT infrastructure that supports digital applications and ensures seamless steady state operations, traffic management, surveillance, emergency response mechanisms and real time tracking of services and vital city metrics throughout the city and in government departments.

GWSCCL is considering the appointment of an agency to set up these priority initiatives identified under the Smart City Mission which will include Integrated Command and Control Center (ICCC) and Smart Elements, including City Surveillance, Area Traffic Control System, Intelligent Transit System and Smart Parking Management System etc.

1.2 Project Objectives

The key objective of this project is to establish a collaborative framework where input from different functional departments of Warangal Municipal Corporation and other stakeholders such as transport, water, fire, police, e-governance, etc. can be assimilated and analysed on a single platform; consequently resulting in aggregated city level information. Further this aggregated city level information can be converted to actionable intelligence, which would be propagated to relevant stakeholders and citizens. Following are the intangibles that should be addressed by the proposed interventions:

- a. Efficient traffic management
- b. Enhanced safety and security
- c. Better management of utilities and quantification of services
- d. Asset Management
- e. Emergency Response
- f. Integration with all existing and future services as identified by Warangal Smart City Corporation limited (GWSCCL) in the city including but not limited to(with provision for future scalability):
 - City Surveillance System
 - Intelligent Traffic Management System
 - Solid waste management
 - Smart Parking
 - Intelligent Transit Systems (ITS)
 - Public Address System

- Environmental sensors
- Smart Lighting
- Smart Governance
- Smart Classrooms
- City Fiber Network
- Water SCADA & Smart Meters
- Sewerage
- Storm water Drainage
- Electrical SCADA and Smart Meters
- Grievance Management
- Geographical Information System
- Public Bike Sharing System
- Warangal City Card/Wallet/Smart Payment
- Fire
- GIS based Property Management
- City MobileApp and Portal
- Smart Library
- Any other sensors/systems

2 Scope of Services for the Project

2.1 Components & Services Overview

The Master System Integrator (MSI) should ensure the successful implementation of the proposed “Area Traffic Control System, Intelligent Bus Transit System, Smart Parking Management, City Surveillance system and Integrated Command and Control Center in Warangal city” and 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 GWSCCL as specified in the scope in this RFP and captured during assessment/requirement gathering phase of project shall essentially be under the scope of the MSI to ensure successful operations of the system and for that no extra charges shall be admissible. MSI shall implement and deliver the following systems and components: Establishment of ITS, City Surveillance, Parking Management, Traffic Control and Monitoring system, Integrated Command and Control Center with provisioning of ICT infrastructure for Data Centre and Disaster Recovery along with integration of the following sub systems already present in the city or envisaged for future

- City Surveillance System
- Intelligent Transit System
- Solid waste management
- Smart Parking
- Multi-Modal Transport Systems (MMTS)
- Panic Button/Emergency Call Box
- Public Address System
- Environmental sensors
- Smart Poles
- Smart Lighting
- Smart Governance
- City Network
- City Wifi
- Water SCADA & Smart Meters
- Sewerage
- Storm water Drainage
- Electrical SCADA and Smart Meters
- E-Medicine/Health
- E-Education

- Disaster Management
- Grievance Management
- Geographical Information System
- Public Bike Sharing System
- City Card/Wallet/Smart Payment
- Fire
- GIS based Property Management
- City Mobile App and Portal
- Smart Library
- Any other sensors/systems

The MSI's scope of work shall include but will not be limited to the following broad areas. Details of each of these broad areas have also been outlined in Annexure II.

1. Assessment, Scoping and Survey Study: Conduct a detailed assessment, scoping study and develop a comprehensive project plan, including:
 - a. Assess existing systems, street infrastructure and connectivity within the city for the scope items mentioned in section 4.1
 - b. Conduct site survey for finalization of detailed technical architecture, gap analysis and project plan
 - c. Conduct site surveys to identify need for site preparation activities
 - d. Obtain site Clearance obligations & other relevant permissions
2. Design, Supply, Installation, Commissioning and Testing which includes the following components:
 - a. Part I: Implementation of following Systems:
 - Area Traffic Control System and associated civil work
 - City Surveillance System and associated civil work
 - Intelligent Transit System
 - Smart Parking
 - Integrated Command and Control Centre
 - ICT Infrastructure for Data Centre (DC) and Disaster Recovery Centre
 - b. Part II: Phase wise Integration of the ICT systems with Integrated Command and Control Centre
 - City Surveillance System

- Intelligent Transit System
- Solid waste management,
- Municipal Vehicle Tracking application already existing with client
- Smart Parking
- Public Address System
- Environmental sensors
- Smart Lighting
- Smart Governance
- City Network
- City Wifi
- Water SCADA
- Sewerage
- Storm water Drainage
- Power SCADA
- Health
- Education
- Disaster Management
- Grievance Management
- Geographical Information System
- Warangal City Card/Wallet
- Fire
- GIS based Property Management
- Warangal City Mobile App and Portal
- Smart Library
- Any other sensors/systems

3. Operation and Maintenance Phase

The selected vendor will also be responsible for supply of IT solution for the management of hardware and application software, networking, installation, Training, Maintenance and operations of the solution for 5 years from the Go Live date of implemented solutions for Warangal in an efficient and effective manner.

4. Integrate with provisions available for Network Connectivity within the city
5. Provisioning Hardware and Software Infrastructure which includes design, supply, installation, and commissioning of IT Infrastructure at Integrated command control center and DC. This consist of:
 - a. Basic Site preparation services
 - b. IT Infrastructure including server, storage, other required hardware, application portfolio, licenses
 - c. Command Center infrastructure including operator 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. Application integration services with other existing and envisaged applications
6. Capacity Building for GWSCCL and any other department which includes preparation of operational manuals, training documents and capacity building support, including:
 - a. Training of the city authorities, police personnel and operators on operationalization of the system
 - b. Support during execution of acceptance testing
 - c. Preparation and implementation of the information security policy, including policies on backup and redundancy plan
 - d. Preparation of revised KPIs for performance monitoring of various urban utilities monitored through the system envisaged to be implemented
 - e. Developing standard operating procedures for operations management and other services to be rendered by ICC
 - f. Preparation of system documents, user manuals, performance manuals, Operation manual etc.
7. Operations and Maintenance services for the software, hardware and other IT and Non-IT infrastructure installed as part of the project after Go-Live for a period of 5 Years of project duration minus implementation period). Warranty period of the product supplied under project i.e. hardware, software, IT/Non-IT etc., will be considered after phase wise Go-Live.

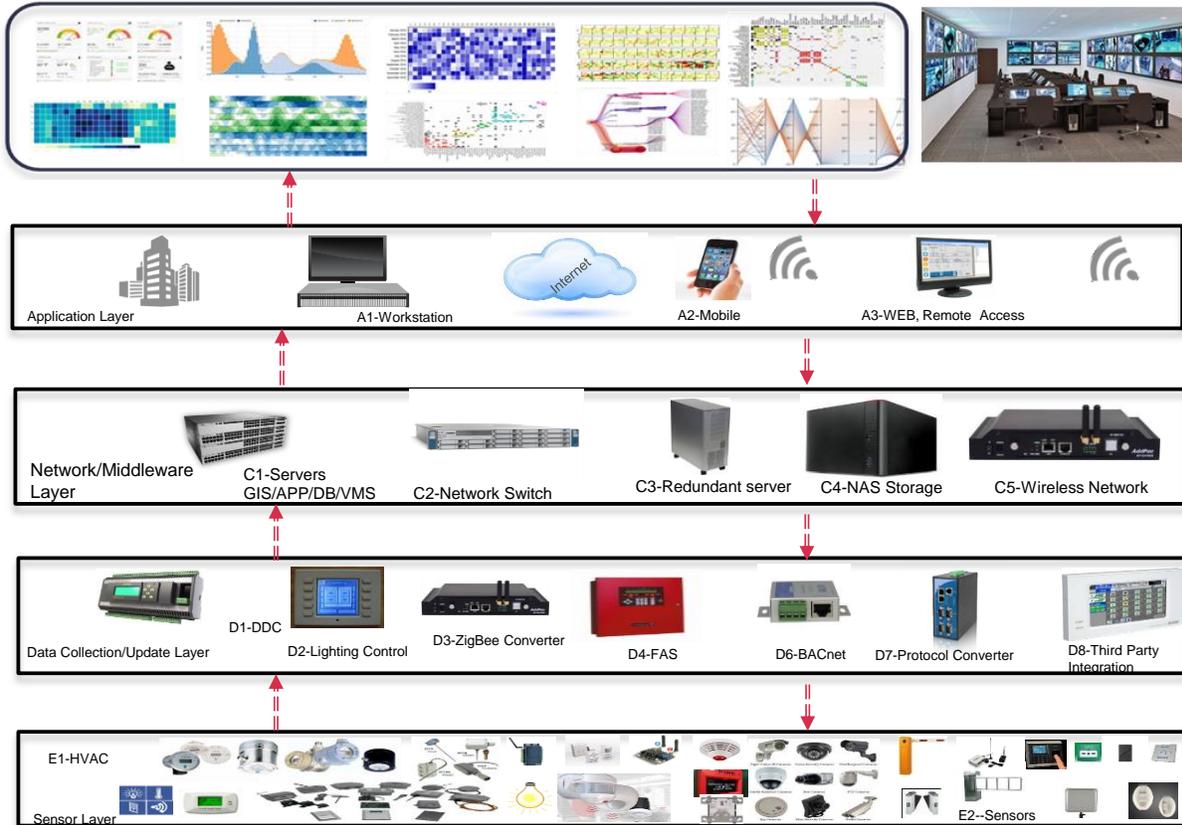
2.2 Scope of services – Phases

The following is a summary of the geographical extent of the project.

#	Scope	Implementation	Integration	Phase
1.	Integrated Command and Control Centre	✓	✓	Phase I
2.	Existing e-Governance		✓	Phase I
3.	City Surveillance System	✓	×✓	Phase I
4.	Area Traffic Control System	✓	✓	Phase I
5.	Smart Parking	✓	✓	Phase I
6.	Intelligent Transit System	✓	✓	Phase I
7.	Disaster Recovery	✓	✓	Phase I
8.	City App Portal	×	✓	Phase II
9.	Smart Lighting	×	✓	Phase II
10.	Education	×	✓	Phase II
11.	e-Governance (New Modules)	×	✓	Phase II
12.	Crowed Sourcing & Community Policy	×	✓	Phase II
13.	GIS	×	✓	Phase II
14.	Sewerage System	×	✓	Phase II
15.	Solid Waste Management	×	✓	Phase II
16.	Water & Power SCADA	×	✓	Phase II
17.	Any other		✓	Phase II

2.3 Solution Architecture

Indicative architecture of the components envisaged under the “Integrated Command and Control Center” is as given below.



a. Sensor and actuator layer

The sensor layer will help the city administration gather information about the ambient city conditions or capture information from the edge level devices like intelligent traffic signals, cameras, enforcement sensors, emergency call boxes, etc. Warangal city is expected to have multiple environmental sensors across the city, to measure ambient conditions such as light intensity, temperature, water level (for chronic flood spots), air pollution, noise pollution and humidity.

b. Data Collection Layer (Controllers)

Controller processes data, that is input from the sensor applies the logic of control and causes an output action to be generated. This signal may be sent directly to the controlled device or to other logical control functions and ultimately to the controlled device.

The controllers function is to compare its input (from the sensor) with a set of instructions such as set point, throttling range and action, then produce an appropriate output signal. It usually consists of a control response along with other logical decisions that are unique to the specific

control application. After taking the logical decision of the information it will hand over the information to the next layer (Network Layer) which will subsequently available at the ICCC.

c. Network Layer

- d. The secured network layer will serve as the backbone for the project and provide connectivity to gather data from sensors and communicate messages to display devices and actuators. It will support the smart elements (sensors and displays) at given locations. The network layer will be scalable such that additional sensors, actuators, display devices can be seamlessly added and Wi-Fi spots created in future. The MSI will be responsible to provide network connectivity for the Project. Please refer Section 2.10 for details

e. Data Centre Layer

The data center layer will house centralized computing power required to store, process and analyze the data to decipher actionable information. This layer includes servers, storage, ancillary network equipment elements, security devices and corresponding management tools. Similar to the network layer, it will be scalable to cater to the increasing computing and storage needs in future.

f. Smart Application and Integration Layer

The smart applications layer will contain data aggregation and management systems (rules engines, alerting systems, diagnostics systems, control systems, messaging system, events handling system), and reporting / dashboard system to provide actionable information to city administrators and citizens. It will be an evolving layer with applications added and integrated as and when new applications are developed at GWSCCL. While aspects of ambient conditions within the city will be gathered through various sensors deployed, some city specific data will come from other government and non-government agencies. It is through the integration layer – that data will be exchanged to and from the under lying architecture components and other data from system developed by government (such as police department, street lights department, water department, irrigation department, transport organizations within Warangal , etc.) and non-government agencies.

g. Service delivery and consumption Layer

The output field devices layer will contain display devices or bi-directional (input & output) devices connected to the network which will be used by citizens to consume - and for administrators to provide - actionable information. Such field devices include digital messaging boards, environmental data displays, etc.

h. Control Units & Command Center Layer

The command center and control units will enable citizens and administrators alike to get a holistic view of city conditions. Such control units will take shape of either an exhaustive command center or control applications which can be viewed over a web browser or available in form of a mobile application. The implementation vendor will have to develop a command center at a site location determined by GWSCCL and web/ mobile based viewing tools for understanding the

ambient city conditions. In addition, the vendor will also have to provision for Secondary Command Control center at CP Head Quarters for Law & Order & Traffic Monitoring and Viewing Center at RTC Hanamkonda for monitoring Inter City Bus Transit Management

i. Security Layer

As ambient conditions, actuators and display devices are now connected through a network, security of the entire system becomes of paramount significance and the MSI will have to provide:

- Infrastructure security- including policies for identity and information security policies
- Network security- including policies and practices adopted to prevent and monitor unauthorized access, misuse, modification, or denial of a computer network and network-accessible resources, etc.
- Identity and Access Management – including user authentication, authorization, SSL & Digital Signatures
- Application security- including Hosting of Government Websites and other Cloud based services, Adoption of Technical Standards for Interoperability Framework and other standards published by GoI for various eGovernance applications
- End device security, including physical security of all end devices such as display boards, emergency boxes etc.

Following security parameters should be included for all smart elements, but not limited to:

- Identity and access management
- User/administrator audit log activity (logon, user creation, date-time of PA announcements, voice recording etc.)
- Secured data storage (storage of video/image/voice/location/data captured by various smart elements)
- SSL/TLS encryption for web and mobile application based interfaces for sensitive data transfer
- Protection against Denial of Service (DoS) and Interference attacks to public Wi-Fi Devices

2.4 Scope and Architecture (to be read with Sec 6 & 7)

The MSI should ensure the successful implementation of the systems in the scope of this RFP and 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 GWSCCL to ensure successful operations of the system shall essentially be under the scope of the MSI and for that no extra charges shall be admissible. MSI shall implement and deliver the following systems and capabilities linked with Interim ICCC/ICCC.

1. Surveillance Cameras with associated civil work
2. Automatic Number Plate Recognition (ANPR) System
3. Red Light Violation Detection (RLVD) System
4. Traffic Violation Cameras
5. Viewing Centres at RTC Hanamkonda
6. Interim ICCC a. at GWMC b. at Police HQ
7. eChallan
8. Integration with existing systems

The schematic diagram below shows the systems envisaged under Area Traffic Control System & City Surveillance System and the information flow across the systems to be integrated.

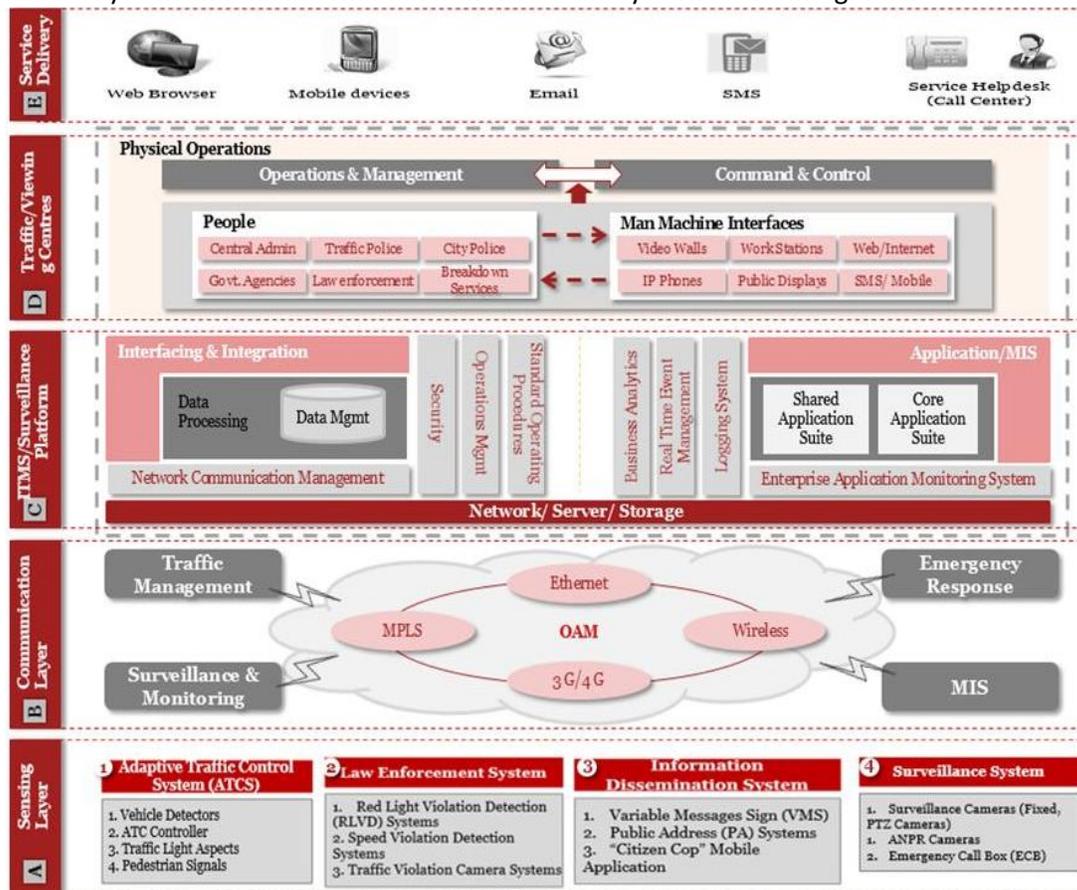


Figure: Logical Architecture of ITMS & City Surveillance System Solution

The MSI's scope of work shall include but will not be limited to the following broad areas. Details of each of these broad areas have also been outlined in subsequent sections of this document:

- 1. Assessment and Site Survey:** Conduct a detailed assessment, site survey and develop a comprehensive project plan, including:
 - a. Assess the existing infrastructure of traffic junctions, traffic management systems, applications. etc. including traffic signaling systems and junction management
 - b. Conduct the site surveys to finalize the location of traffic signal controller, number of traffic signal aspects, Camera distribution systems, locations and height of poles, cantilever, junction box, and cable routing etc.
 - c. Finalization of detailed technical architecture, gap analysis and project plan
 - d. Develop traffic management plans for individual signal controls and groups of signal controllers along with pre-planned intervention strategies for special scenarios
 - e. Obtain site Clearance obligations & other relevant permissions
- 2. Design, Supply, Installation and Commissioning of Field Equipment** which includes the following components:
 - a. Surveillance Cameras
 - b. Automatic Number Plate Recognition (ANPR) System
 - c. Red Light Violation Detection (RLVD) System
 - d. Traffic Violation Cameras
 - e. Variable Message Sign boards
 - f. MSI shall provide the required network connectivity and capacity as per their proposed solution design for the project. The network connectivity as mentioned here will include the core backbone Wide area network connecting Data Center, Command Centers and Viewing Centers with all edge devices at field locations. It is expected that this network connectivity is to be provided on lease basis by suitable Network Service Provider as proposed by the MSI.
 - g. Integrating live data streams with Data Centre, Viewing Centers, ICC and other envisaged command centres of City Surveillance and Traffic ,RTC Warangal
 - h. Migration of all systems covered in this RFP from existing network to Telangana Fiber Grid or SPV owned network should it be operational during the contract duration
- 3. Hosting of Hardware and Software Infrastructure** which includes design, supply and installation and commissioning of IT Infrastructure for Data Centre, Viewing Centres, and ICC. This consist of:
 - a. IT Infrastructure including server, storage, other required hardware, application portfolio, licenses

- b. Interim ICCC/ICCC infrastructure including video walls, operator workstations, IP phones, joystick controller etc.
- c. Viewing Centre infrastructure including LED displays, operator workstations, IP phones etc.
- d. Establishment of LAN and WAN connectivity at Viewing Centers, Interim ICCC/ICCC and DC limited to scope of infrastructure procured for the project
- e. Application integration services with control centres of ICCC, Surveillance and Traffic and RTC Warangal
- f. The solution as proposed by the MSI should be able to integrate with external systems such as Dial 100, Dial 112 etc. to support execution of SOPs and help in other operational activities.
- g. Surveillance and Traffic enforcement system of Warangal ICCC should be integrated with the E-Challan system procured under the scope of this project.

4. Capacity Building for Warangal Police, GWSCCL, and Warangal MC which includes preparation of operational manuals, training documents and capacity building support, including:

- a. Training of the city authorities, Police personnel and ICCC operators on operationalization of the system
- b. Support during execution of acceptance testing
- c. Preparation and implementation of the information security policy, including policies on backup and redundancy plan
- d. Preparation of revised traffic signal control plans, alternate signal control plans, KPIs for performance monitoring of transport network, dashboards for MIS
- e. Developing standard operating procedures for operations management and other technical services to be rendered by Interim ICCC/ICCC
- f. Preparation of system documents, user manuals, performance manuals, etc.

Operations and Maintenance services for the software, hardware and other IT and Non-IT infrastructure installed as part of the project for 5 years after Phase wise Go-Live i.e. For example, As Phase 1 will Go-Live after 6 months, the O&M period of Phase 1 will commence after Go-Live and will be for a period of 5 years Warranty period of the product supplied under project i.e hardware, software, IT/Non-IT etc., will be considered after phase wise Go-Live. All specifications proposed in this RFP are minimum specifications which the MSI is required to comply with. However, MSI can propose solution with better specifications while designing their overall solution.

Geographical Scope of services

The following is a summary of the geographical extent of the project. Due exercise in terms of places of installation of Traffic Junctions , Cameras for Surveillance and connectivity has to be carried out by the MSI by survey and approval from City Planning authority and Client has to be taken to confirm the locations of priority. Bidder to note the location number provided in Annexure V is Indicative and may vary (+/_ 5 %) after actual survey (to be carried out by bidder self).

#	System Description	Locations
1.	Intelligent Traffic Signals	40 Locations
2.	Surveillance Cameras (Fixed and PTZ)	120 Locations
3.	ANPR Cameras	40 Locations
4.	Red Light Violation Detection System at Intersection	40 Locations
5.	Traffic Violation Cameras	50 Locations
6.	Viewing Centers	1 Locations
7.	Smart Parking System	14 Locations
8.	ICCC	2 Location (approximately 3000 Square Feet) Bidder to visit the site and propose the design for acceptance

The Indicative list of locations to be covered under this project are provided as Annexure V.

2.5 Assessment and Site Survey for finalization of detailed technical architecture and project plan

After signing of contract, the Systems Integrator needs to deploy local team (based out of Warangal) proposed for the project and ensure that a Project Inception Report is submitted to WSSCL (refer Project Deliverables and Timelines in Sec. 6 & 7 resp.) which should cover following aspects:

1. Names of the Project Team members, their roles and responsibilities
2. Approach and methodology to be adopted to implement the Project (which should be in line with what has been proposed during bidding stage, but may have value additions / learning in the interest of the project).
3. Responsibility matrix for all stakeholders
4. Risks the MSI anticipates and the plans they have towards their mitigation
5. Detailed project plan specifying dependencies between various project activities / sub-activities and their timelines
6. Installation locations geo mapped preferably on google earth to visually identify the geographical area

The MSI shall conduct a comprehensive As-Is study of the existing infrastructure of traffic junctions/intersections (identified for ITMS & City Surveillance) during various time periods of day including peak and non-peak hours to establish the key performance indicators(KPI) for the project. The KPIs of the study shall be included in the survey. The following minimum parameters should be captured during the comprehensive study

1. Volumes of vehicles moving in the road network within the area identified for ITMS implementation
2. Vehicle type distribution
3. Directional distribution
4. Physical and visual characteristics of the area
5. Travel times, delays between different points of the network
6. Additional dependencies with respect to the available infrastructure and geometry at the junctions
7. Any other relevant data which the MSI anticipates will assist in establishing the benchmarks for the project

The report shall also include the expected measurable improvements against each KPI as detailed out in the above 'As-Is' study after implementation of ITMS & City Surveillance project. The benchmarking data should also be developed to track current situation and desired state.

The MSI shall study the existing business processes, functionalities, existing traffic management systems and applications including MIS reporting requirements.

The MSI will be responsible to propose transition strategy for dismantling of existing signal, and setting up of new signals and field components. The proposed strategy should clearly provide approach and plan for implementing the new signals and field components while ensuring minimum disturbance to the road traffic and shall use appropriate static signage designating the work in progress status.

Additionally, the MSI should provide a detailed To-Be designs (Junction layout plans in coordination with authorities' as Junction design changes is envisaged as part of Master plan) specifying the following:

1. High Level Design (including but not limited to) Application architecture, Logical and physical database design, Data dictionary and data definitions, ER diagrams and other data modelling documents and Physical infrastructure design for devices on the field
2. Application component design including component deployment views, control flows, etc.
3. Low Level Design (including but not limited to) Application flows and logic including pseudo code, GUI design (screen design, navigation, etc.), Database architecture, including defining data structure, data dictionary as per standards laid-down by Government of India/ Government of Telangana
4. Location of all field systems and components proposed at the junctions, (KML /KMZ file plotted on GIS platform like google earth etc.)
5. Height and foundation of Cameras, Traffic Signals and Standard Poles for Pedestrian signals, Height and foundation of Poles, cantilevers, gantry and other mounting structures for other field devices
6. Location of Junction Box
7. Location of Network Provider's Point of Presence (PoP)
8. Design of Cables, Ducts routing, digging and trenching and reinstatement
9. Electrical power provisioning

The MSI shall also identify the customizations/ workaround that would be required for successful implementation and operation of the project. The report should take into consideration following guiding principles:

1. **Scalability** - Important technical components of the architecture must support scalability to provide continuous growth to meet the growing demand of the city. The system should also support vertical and horizontal scalability so that depending on changing requirements from time to time, the system may be scaled upwards. There must not be any system imposed restrictions on the upward scalability in number of field devices. Main technological components requiring scalability are storage, bandwidth, computing performance (IT Infrastructure), and software / application performance. Command Centers would have to be provisioned at CP HQ and GWMC HQ and feeds of Bus Transit Management should be available at both RTC and GWMC. Operational activities will be carried out at GWMC HQ, Police HQ and RTC Hanamkonda
2. **Availability** - Components of the architecture must provide redundancy and ensure that are no single point of failures in the key project components. Considering the high sensitivity of the system,

design should be in such a way as to be resilient to technological sabotage. To take care of remote failure, the systems need to be configured to mask and recover with minimum outage. The MSI shall make the provision for high availability for all the services of the system.

3. **Security** - The architecture must adopt an end-to-end security model that protects data and the infrastructure from malicious attacks, theft, natural disasters etc. MSI must make provisions for security of field equipment as well as protection of the software system from hackers and other threats. Using Firewalls and Intrusion detection systems such attacks and theft should be controlled and well supported (and implemented) with the security policy. The virus and worms attacks should be well defended with gateway level Anti-virus system, along with workstation level anti-virus mechanism. Furthermore, all the system logs should be properly stored & archived for future analysis and forensics whenever desired. WSCCL may carry out the Security Audit of the entire system post acceptance / operationalization through a Third Party Auditor (TPA) if required and will bear the cost. The following guidelines need to be observed for security:
 - a. Build a complete audit trail of all activities and operations using log reports, so that errors in system – intentional or otherwise – can be traced and corrected.
 - b. Access controls must be provided to ensure that the system is not tampered or modified by the system operators.
 - c. Implement data security to allow for changes in technology and business needs.
 - d. The security of the field devices must be ensured with system architecture designed in a way to secure the field devices in terms of physical damage & unauthorized access.
4. **Manageability** - 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 scalability of the system
5. **Interoperability** - The system should have capability to take inputs from other third party systems as per situational requirements
6. **Open Standards** - System should use open standards and protocols to the extent possible without compromising on the security
7. **Convergence** - GWSCCL has already initiated many projects which have state of the art infrastructure at field locations deployed under them. The Area Traffic Control System & City Surveillance Infrastructure should be made scalable for future convergence needs. Under the smart city program, GWSCCL has envisaged to create a state of the art infrastructure and services for the citizens of Warangal, hence it is imperative that all infrastructure created under the project shall be leveraged for maximum utilization. Hence the MSI is required to ensure that such infrastructure will allow for accommodation of equipment's being procured under other smart city projects. Equipment like Junction Boxes and poles deployed under the ITMS& City Surveillance project at the field locations will be utilized to accommodate field equipment's created under the other projects of GWSCCL The procedure for utilization of the infrastructure will be mutually agreed between the GWSCCL and MSI

Sub-contracting / Outsourcing shall be allowed only for the work which is allowed as mentioned in Volume 1 clause 2.27 with prior written approval of GWSSCL. However, even if the work is sub-contracted / outsourced, the sole responsibility of the work shall lie with the MSI. The MSI shall be held responsible for any delay/error/non-compliance etc. of its sub-contracted vendor. The details of the sub-contracting agreements (if any) between both the parties would be required to be submitted to GWSSCL. Sub-contracting / outsourcing would be allowed only for work such as:

1. Passive Networking & Civil Work during implementation,
2. FMS staff for non- IT support during post-implementation
3. Services of professional architect for design of Interim ICCC/ICCC and viewing centers

2.6 Site Clearance obligations & other relevant permissions

2.6.1 Survey and Commencement of Works

Prior to starting the site clearance, the MSI shall carry out survey of field locations as specified in Annexure V, for buildings, structures, fences, trees, existing installations, etc. The GWSCCL shall be fully informed of the results of the survey and the amount and extent of the demolition and site clearance shall then be agreed with the GWSCCL.

2.6.2 Existing Traffic Signal system

The infrastructure of existing traffic signal systems including the aspects, controllers etc. will be dismantled and replaced with the new systems which is proposed and required under the scope of the ITMS & City Surveillance project. The dismantled infrastructure shall be delivered at the GWSCCL designated location without damage at no extra cost.

2.6.3 Road signs

All existing road signs which are likely to be effected by the works are to be carefully taken down and stored. Signs to be re-commissioned shall be cleaned, provided with new fixings where necessary and the posts re-painted in accordance with GWSCCL guidelines. Road signs, street name plate, etc. damaged by the MSI during their operation shall be repaired or replaced by MSI at no additional cost.

2.6.4 Electrical works and power supply

For successful commissioning and operationalization of the edge devices and to provide the video feeds to Command and Control Centers and Viewing centers, the Successful bidder will be required to provide electricity to the edge devices through aggregation points. Bidder has to plan the power back-up based upon the power situation in the city.

Since this component has dependency on approval from other agencies, it is recommended that SI plans this requirement well in advance and submits application to concerned Electricity distribution agency . Registration of electrical connections is to be done in the name of GWSCCL. The SI has to carry out study and identify locations to provide UPS back-up so as to meet camera up-time requirements. The Authority shall provide necessary support to successful bidder (support in terms if documentation, meetings with concerned authorities) for getting approvals from concerned authorities, if all the necessary requirements from the successful bidder are in place

The initial cost to apply to new connection shall be borne by SI. However, recurring cost of electricity bills at Command Control Centers, Viewing Centers, Data Center, Edge Devices shall be borne by the authority after Go-Live or handover of the project upon receipt of invoices payable at actuals.

2.6.5 Lightning-proof measures

The MSI shall comply with lightning-protection and anti –interference measures for system structure, equipment type selection, equipment earthing, power, signal cables laying. The MSI shall describe the planned lightning-protection and anti –interference measures in the As-Is report. Corresponding lightning arrester shall be erected for the entrance cables of power line, video line, data transmission cables. All

crates shall have firm, durable shell. Shell shall have dustproof, antifouling, waterproof function & should be capable to bear certain mechanical external force. Signal separation of low and high frequency; equipment's protective field shall be connected with its own public equal power bodies; small size/equipment signal lightning arrester shall be erected before the earthling. The Internal Surge Protection Device for Data Line Protection shall be selected as per zone of protection described in IEC 62305, 61643-11/12/21, 60364-4/5. Data line protection shall be used for security system, server data path and other communication equipment. Data line protection shall be installed as per zone defined in IEC 62305. Type 1 device shall be installed between zone 0B and zone 1. Type 2 devices shall be installed before the equipment in zone 2 and 3.

2.6.6 Earthing System

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 IT infrastructure i.e signal junction or command centre shall have adequate earthing. Further, earthing should be done as per Local state national standard in relevance with IS standard.

1. 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. WSCCL shall provide the necessary space required to prepare the earthing pits.
2. All metallic objects on the premises that are likely to be energized by electric currents should be effectively grounded.
3. 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.
4. The earth connections shall be properly made.
5. A complete copper mesh earthing grid needs to be installed for the server farm area, every rack need to be connected to this earthing grid. A separate earthing pit needs to be in place for this copper mesh.
6. Provide separate Earthing pits for Servers, & UPS as per the standards.

2.6.7 Junction Box, Poles and Cantilever

1. The MSI shall provide the Junction Boxes, poles and cantilever to mount the field sensors like the cameras, traffic sensors, traffic light aspects, active network components, controller and UPS at all field locations, as per the specifications given in the RFP.
2. The Junction Box needs to be appropriately sized in-order to accommodate the systems envisaged at the Junctions, and the MSI should design the Junction box for 1.5 times the actual size the MSI requires for utilization under the Area Traffic Control System & City Surveillance project.
3. The Additional 50% space in the Junction Box shall be utilized by GWSCCL to accommodate any future requirements under other projects

4. The Junction Box for UPS with Battery bank needs to be considered separately
5. It should be noted that the MSI would have designed the Junction box keeping in mind the scalability requirements of Area Traffic Control system & City Surveillance project, and the additional 50% volume needs to be considered over and above such requirement
6. The junction box should be designed in a way that, separate compartment will be available for separate system (i.e. ITMS Controller, Mini server, Active component, etc.). Each compartment shall have lock & key facility. There should be provision made to integrate the systems if required.

2.6.8 Cabling Infrastructure

1. The MSI shall provide standardized cabling for all devices and subsystems in the field, Viewing Centers and Interim ICC/ICCC.
2. MSI 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 shall be routed down the inside of the pole and through underground duct to the outstation cabinet.
3. All cables shall be clearly labeled with indelible indications that can clearly be identified by maintenance personnel. The proposed cables shall meet the valid directives and standards.
4. Cabling must be carried out per relevant BIS standards. All cabling shall be documented in a cable plan by the MSI.

2.6.9 Design, Supply, Installation & Commissioning of the Field Equipment

The Scope includes Supply, Installation, commissioning and Customization (as required) of various field systems which include, Surveillance Cameras, ANPR Cameras, PA System, Variable Message Signs, Red Light Violation Detection system, Traffic Violation cameras, and other IT infrastructure required for successful operation of the ITCS and City Surveillance modules.

Based on the approved Survey report, the MSI will undertake the system configuration and customization in line with the changed, improved or specific requirements of Warangal Police and GWSCCL including:

1. The implementation methodology and approach must be based on the global best practices in order to meet the defined Service Levels during the operation.
2. Best efforts have been made to define major functionalities for each sub- system of ATCS and City Surveillance system. However, MSI should not limit its offerings to the functionalities proposed in this RFP and is suggested to propose any functionality over and above what has already been given in this tender.
3. The MSI shall design the field level equipment architecture to ensure maximum optimization of network equipment, poles, cantilever, mounting infrastructures, power supply equipment including, electric meters and junction box.

4. Finally approved/accepted solution for each component of ATCS & Surveillance systems shall be accompanied with “System Configuration” document and the same should be referenced for installation of ITMS and Surveillance systems at Junctions that are identified within the scope of this project.
5. The MSI shall be required to submit a detailed installation report post installation of all the equipment at approved locations. The report shall be utilized during the acceptance testing period of the project to verify the actual quantity of the equipment supplied and commissioned under the project.
6. The MSI shall be responsible for obtaining all permits and approvals necessary to install the ITCS and Surveillance systems components as per the approved design.

2.7 GWSCCL Surveillance System

City Safety and Security solution helps protect cities against crime, terrorism, and civil unrest, planning events, monitoring of infrastructure, encroachments etc. It helps law enforcement monitor public areas, analyze patterns, and track incidents and suspects enabling quicker response.

Keeping the above perspective, GWSCCL for this purpose is intending to implement the high definition IP based surveillance cameras across various locations within City. The exact location and number will be finalized after detailed survey by the successful bidder, post award of the contract. The cameras should be housed on the intelligent/street poles. It shall also be possible to adjust the camera focus from a remote location. The quantity of cameras may vary to a maximum of (+ /- 5 % of the proposed BoQ)

For more details on technical and functional specifications of Surveillance Cameras, MSI should refer to Annexure I for Functional and Technical specifications

Following is an indicative scope of work;

- The MSI shall install Surveillance Cameras for CCTV monitoring and management across the Warangal and ABD area. The plan of Installations has to be submitted to GWSCCL and Police for approval before undertaking any activity.
- Installation and commissioning work includes installation of all required Video Management System, cameras, monitors, cables laid in PVC conduit etc, commissioning all the systems at the pre-defined locations (including laying, digging, trenching and reinstatement) in the project area
- The Bidder shall prepare the final camera distribution plan at all the camera locations in discussion with Warangal Smart City Corporation Limited and other stakeholders (police etc.)
- Actual location for placement of pole & number of cameras at each location, type of cameras, fixation of height & angle for the cameras would be done carefully to ensure optimum coverage
- Bidder should use the industry best practices while positioning and mounting the cameras. Some of the check-points which need to be adhered by the Bidder while installing / commissioning cameras are as follows:

- Ensure Project objectives are met while positioning the cameras, creating the required field of view
 - Ensure appropriate housing is provided to protect camera from the on field challenges
 - Carry out proper adjustments to have the best possible image
 - Ensure that the pole /tower/ mast implementation is vibration resistant
 - During implementation period, in case any camera is damaged by a vehicular accident (or due to any other reason outside the control of Bidder) and needs repair, then the Bidder will need to repair / have the new camera within 15 days of the incidence. Damages are to be borne by Bidder in such cases through proper insurance.
1. The MSI shall undertake due diligence for selection and placement of surveillance cameras to ensure the optimized coverage of the traffic junction and location along with all associated junction arms, accuracy of the information captured on the field and for rugged operations.
 2. The MSI shall design, supply, and install the surveillance cameras as defined in the RFP; all wiring connections for the system shall be installed by the MSI. The MSI shall supply all of the necessary equipment for the camera operations including camera housings and mountings, camera poles, switches, cabling, and shall make the final connections to the junction box.
 3. The MSI shall be responsible for providing the entire necessary IT infrastructure for monitoring, recording, storage & retrieval of the video streams at Interim Command Control Center at CP HQ for Law& Order & Traffic, ICCO at WMC or any other location as specified in the RFP.
- MSI shall undertake detail assessment for integration of the ATCS, Surveillance system with the Geographical Information System (GIS) so that physical location of ATCS, Surveillance and other major edge devices are brought out on the GIS map. MSI has to check the source and reliability position accuracy attribute authenticity and methods have to be advised to reduce the error to carry out the seamless integration to ensure ease of use of GIS in Command Control Centers, GWSCCL and by higher management. The MSI has to use existing Base map which will be available through API for integration. SI is required to update GIS maps (including the additional layers of data as required for proposed solution) from time to time.
 - Different layers to be covered under GIS are as follows:
 - ATCS, Surveillance and other major edge devices
 - Major Buildings / Structures
 - Roads

- Others as necessary

Geographical coverage of the project is the jurisdiction of Warangal Municipal Corporation. MSI shall supply viewing software for GIS Maps and shall ensure that GIS application is integrated with VMS to support the Command Centre /GWSSCCL personnel to navigate on the map and use it for better spatial understanding. It should also help higher management of GWSSCCL & Warangal Police Department to analyze the events on a spatial perspective.

- Existing cameras: Around 100 cameras are installed by Police department which are currently being monitored at their respective Police stations based on their jurisdiction. These cameras needs to be integrated with Interim CCC at Police HQ.
- Apart from the existing cameras as mentioned above, 16000 community cameras are expected to be integrated with ICCC in the future. Bidder will be responsible to ensure that proposed VMS, ICC infrastructure (hardware as well as software) should be capable of scaling to further addition of 16000 cameras in future. However for commercial discovery, Bidder to consider the licenses, compute and other dependencies for integration of about 100 community cameras (locations details will be provided by the Police) over ONVIF under current requirement.
- Bidder shall carry out SMS Gateway Integration with the Surveillance System and develop necessary applications to send mass SMS to groups/individuals, which can be either manual or system generated. Any external/third party SMS gateway can be used, but this needs to be specified in the Technical Bid
- Bidder will have to identify and obtain necessary legal / statutory clearances for erecting the poles and installing cameras, for provisioning of the required power, etc; the same will be facilitated by WSCCL. It is important to mention that a timely communication and required follow-up will be required by the Bidder for the clearances
- During implementation period, in case the pole is damaged by a vehicular accident (or due to any other reason outside the control of MSI) and needs repair, then the MSI will need to repair / have the new pole within 15 days of the incident. Damages are to be borne by MSIs in such cases through proper insurance
- For the successful commissioning & operation of the edge devices and to provide the video feeds to Command Control Centers, the Bidder will be required to provide electricity to the edge devices through the aggregation points. Bidder has to plan the power backup based upon the power situation across the city
- The Bidder will be responsible for the solution deployment / customization for implementing end-to-end Surveillance System including its integration with other components as required.
- The Bidder will ensure that the best practices for software development and customization are used during the software development/customization and implementation exercise
- CCTV online data is required to be connected to Police Control Room/Command Center, the Bidder will connect it to the same

- CCTV feeds should be made available at each Police station (list provided in annexure) for integration with viewing centers to be set-up in future.
- Provision to store / record / view the feeds at each Police station at a future date.
- The Interim Command Center at Police HQ is proposed to be moved to new facility in HQ premises at a later point within the duration of contract and the bidder will assist in so-doing
- Specification of the surveillance system is mentioned in section 6.5

2.8 GWSCCL Area Traffic Control System

2.8.1 ANPR Cameras

The broad scope of work to be covered under this sub module will include the following, but is not limited to:

1. The MSI shall install the ANPR Cameras at 40 junctions/locations across the city. Bidder will carry out site survey and arrive at actual locations (variance can be +/- 10 %) This system shall automatically capture the license number plate of the vehicle at these junctions.
2. The MSI shall design, supply, and install the ANPR camera system as defined in the RFPs, all camera accessories such as IR Illuminators, camera housing and mounting shall be installed by the MSI. The MSI shall supply all of the necessary equipment for the camera and local processing system, including but not limited to: computers, local storage, and ancillary camera equipment, camera poles, warning signs and shall make the final connections to the camera.
3. The MSI shall be responsible for providing all the necessary IT infrastructure for detection, analysis, storage & retrieval of the number plate information at ICC or any other location as specified in the RFP.
4. For more details on technical and functional specifications of ANPR Cameras, MSI should refer to Annexure I for Functional and Technical specifications.

2.8.2 Red Light Violation Detection (RLVD) System

The broad scope of work to be covered under this sub module will include the following, but is not limited to:

1. The MSI shall install the RLVD Systems at 40 traffic junctions across the city. Bidder will carry out site survey and arrive at actual locations (variance can be +/- 10 %) This system shall capture the infractions of Red light and stop line violations at these junctions. It is MSI's responsibility to get confirmation on places of installation after due approvals from the Client.
2. The MSI shall design, supply, and install the RLVD system as defined in the RFPs, all wiring connections to the traffic signal controllers and to the camera platforms shall be installed by the

MSI. The MSI shall supply all of the necessary equipment for the camera and detection system, including but not limited to: computers, ancillary camera equipment, camera housings, camera poles, warning signs and shall make the final connections to the camera.

3. The solution proposed by the MSI shall seamlessly integrate with the E-Challan system proposed under the scope of this project. GWSCCL shall facilitate to get access to the RTO. Bidder shall be required to access the same through use of appropriate APIs.
4. The MSI shall be responsible for providing all the necessary IT infrastructure for analysis, storage & retrieval of the infraction information at Interim ICC/ICCC or any other location as specified in the RFP.
5. For more details on technical and functional specifications of Red Light Violation Detection (RLVD) system, MSI should refer to Annexure I for Functional and Technical specifications.

2.8.3 Traffic Violation cameras

The broad scope of work to be covered under this sub module will include the following, but is not limited to:

1. The MSI shall install additional fixed cameras with ANPR capability for detection of violations of wrong side vehicle movements at across the city.
2. The MSI shall design, supply, and install the traffic violation cameras as defined in the RFPs, all wiring connections for the system shall be installed by the MSI. The MSI shall supply all of the necessary equipment for the camera and detection system, including but not limited to: computers, ancillary camera equipment, camera housings, camera poles, warning signs and shall make the final connections to the camera.
3. The solution proposed by the MSI shall seamlessly integrate with the E-Challan system proposed under the scope of this project.
4. The MSI shall be responsible for providing all the necessary IT infrastructure for analysis, storage & retrieval of the infraction information at ICC/ICCC or any other location as specified in the RFP.
5. For more details on technical and functional specifications of Traffic Violation Detection system, MSI should refer to Annexure I for Functional and Technical specifications.

2.8.4 E-Challan Devices

The MSI is required to supply 50 devices along with e-Challan application for spot challan issuance. The MSI is required to seamlessly integrate the handheld e-Challan application with the E-Challan system proposed under the scope of this project.

2.9 Smart Parking Management

Greater Warangal Municipal Corporation doesn't own and manage any parking lots as of now. Citizen's park their vehicles as and where required especially on the road. This has led to congestion and traffic

owes across the city. Due to these parking woes, the pedestrian facility is encroached causing safety and security issues.

The scope of the SI is to create the infrastructure and maintain it as part of the O&M. However it is the responsibility of the GWMC for operationalization of the Parking Lots and their optimal utilization for revenue generation.

The Traffic Police department along with GWMC has identified 14 locations in the tri city of Greater Warangal. It has been assumed that 3 of them would be on street parking and 11 would be off-street parking.

Exact number of locations to be finalized by GWSCCL, Please see Annexure V for Parking Sites.

The scope of the project for the system integrator (SI) shall be to:

1. Provide the infrastructure required for the Smart Parking solution at the parking lot (Ticket vending machines, hand-held devices, Payment kiosks, Electric Vehicle Charging, parking sensors, Variable Messaging Displays, etc.)
2. Provide the hardware and software required for a centralized view of all the parking lots (Central Server, local clients, Backup and DR, etc.)
3. Provide the backhaul network which acts as communication layer for real time data from sensors to reach data center.
4. Provide a citizen interface (mobile app and web interface) for booking and guidance to parking lots and also provide this capability as service in the proposed one citizen app by integrating with the same when available.
5. Undertake Operation and Maintenance of the manpower, hardware and software supplied, installed and commissioned by it as part of solution for a period of 5 years.(Ex- ticket vending machines, parking sensors, parking servers, mobile apps etc.).
6. Provide SLA monitoring tools like network monitoring and enterprise management tools.
7. Training of the parking subcontractors & Municipal Corporation

Integration with ICCC

- The centralized smart parking solution will be integrate with the Integrated Command and Control Center (ICCC) and provide real-time statistics and data along with control to the operators and other stakeholders in the ICCC.
- The solution must integrate with e-Vahan/ National Vehicle Registration Database along with any other stolen vehicle database proposed in the future.
- The Smart card that will be implemented through separate tender will also be integrated with the smart parking solution. By doing so, we can provide a rich smart parking experience for the card holders. It's assumed that the Smart Card will have integrations with the standard Payment Gateways.

- The parking solution also needs to be integrated with City Mobile apps / Smart payments system for allowing online slot reservations and payments.
- Integration with Asset Management system to keep a track and maintain identity of all assets used in this project.

2.10 Integrated Command and Control Centre

The Bidder has to integrate all the components at centralized command and control center with an integrated operations and dashboard application that will integrate various Smart City components implemented in this project and in future.

The Integrated command and control center can monitor and control, via the centralized application, the smart components like, Smart Surveillance.

1. Currently a site has been allocated for ICCC premises (details in Annexure 12.5). A new facility is being planned for construction and the ICCC is envisaged to be migrated to the new premise at a later point in time within the duration of the contract .MSI has to ensure seamless migration to the new facility **Integrated Command and Control Centre at Warangal Municipal Corporation:**

Integration with	View	Control	Full Operations
E-Governance applications, City Portal , Mobile App (not in current scope of RFP)	Yes	Yes	Yes
City Surveillance	Yes	Yes	Should be possible
Traffic Monitoring	Yes	Yes	Should be possible
Municipal Vehicle Tracking and other vehicles (fire , etc.)	Yes	Yes	Yes
Bus Intelligent Transit System	Yes	Yes	Should be possible
Smart Parking	Yes	Yes	Should be possible
Other components Electrical SCADA, Water SCADA (provision to be made in future)	Yes	Yes	Should be possible

2. **Secondary Command and Control Center at Police Head Quarters**

Integration with	View	Control	Full Operations
City Surveillance system	Yes	Yes	Yes
City Traffic Management System	Yes	Yes	Yes

Should have provision for Command and Control center over a Mobile platform

Bidder should provision for Mobile Client application. Number of Mobile users accessing the CCC application will be provided after discussion with Client.

All the hardware and software issues will be the responsibility of the Bidder.

2.11 City wide Network Connectivity for the Project

1. Network & Backbone Connectivity is an important component of the project and needs very careful attention in assessment, planning and implementation. It is important not only to ensure that the required connectivity is provisioned within the required timelines but also ensure that it is reliable, secure and supports the required SLA parameters of Latency, Jitter, Packet Loss and Performance.
2. MSI shall provide the required network connectivity and capacity as per their proposed solution design for the project. The network connectivity as mentioned here will include the core backbone Wide area network connecting Data Center, Command Centers and Viewing Centers with all edge devices at field locations. It is expected that this network connectivity is to be provided on lease basis by suitable Network Service Provider as proposed by the MSI.
3. Telangana State government proposes to introduce Telangana Fiber Grid Network or SPV Owned Fiber Network to deliver Government to Citizen (G2C) and Government to Government (G2G) services– by providing high speed broadband connectivity to government offices, educational institutions, hospitals, banks and other public service institutions. Through this program, Bandwidth Provision is proposed to be provided by the state.
4. It will be the responsibility of the MSI to migrate the entire network connectivity for the project from current proposed NSP to Telangana Fiber Grid network or SPV Owned Fiber Network backbone once implemented as part of the above state wide implementation. MSI shall also develop a migration plan for migrating to Telangana Fiber Grid network as and when it is available and operational during the duration of this contract.
5. Migration procedure should be implemented within one month of operationalization and availability of Telangana Fiber Grid network or SPV Owned Fiber Network. MSI shall be required to submit a detailed migration report post switching of all field equipment
6. Recurring charges for the City Wide Network connectivity taken on lease for the project to be provisioned by the MSI for the duration of the project including O&M or till the time of availability of State Wide Fiber or SPV Owned Fiber Network
7. MSI is expected to do the site surveys and estimate for the last mile infrastructure and propose suitable network design and network service provider.
8. Bidder shall provide the dedicated and redundant connectivity between DC and ICCS at GWMC and CP Head-quarters and Viewing centers. as per SLA defined in Volume 1
9. Required RoW/RI charges shall be borne by the Authority. However, the Bidders are required to provide detailed estimates post award of the contract

10. The MSI should provide a detailed network architecture of the overall system, incorporating findings of site survey exercise. The network so envisaged should be able to provide real time data streams to the Data Centre with appropriate capacity. All the components of the technical network architecture should be of industry best standards and assist MSI in ensuring that all the connectivity SLAs are adhered to during the operational phase.
- 11.
12. The MSI is also responsible for providing network services for integration for below connectivity requirements:
 - a. Between Data Centre and Command centers
13. The MSI shall prepare the overall network connectivity plan for this project. The plan shall comprise of deployment of network equipment at the junctions to be connected over network, any clearances required from other government departments for setting up of the entire network. The network architecture proposed should be scalable and in adherence to network security standards. It is necessary that at least 80% of the proposed connectivity should be wired
14. The MSI shall also provide network architecture for integration & migration of ATCS & City Surveillance system along with other smart solutions in the RFP with Network.
15. MSIs are also required to do the estimation of bandwidth requirements considering following benchmark parameters

#	ATCS & City Surveillance and other components	Consideration
1.	PIS Boards at bus shelters	<ul style="list-style-type: none"> • Minimum 1 MB for each location
2.	Surveillance Cameras	<ul style="list-style-type: none"> • Resolution: 1920x1080 • Frame Rate: 25 fps
3.	Traffic Violation Cameras	<ul style="list-style-type: none"> • Resolution: 1920x1080 • Frame Rate: 25 fps
4.	RLVD	<ul style="list-style-type: none"> • Video footage of incident (t-5 seconds to t+5 seconds, where 't' is time of incident) at required high resolution • Minimum 4 Images of violating vehicle along with Number plate
5.	Smart Parking	<ul style="list-style-type: none"> • Estimated at < 500Kb at each location

16. The actual bandwidth requirement to cater the above mentioned bandwidth parameters and to meet SLAs would be calculated by the MSI and the same shall be clearly proposed in the technical proposal with detail calculations. GWSCCL also requires the MSI to meet the parameters of video

feed quality, security & performance and thus MSIs should factor the same while designing the solution. GWSCCL reserves its right to ask the Systems Integrator to increase the bandwidth if the provided bandwidth is not sufficient to give the functionality of the system mentioned in the RFP and adhere to the SLAs.

17. In case the Telecommunication guidelines of Government of India require the purchaser to place Purchase Order to the Service Provider for bandwidth, WSCCL shall do so. However, Systems Integrator shall sign a contract with Telecom Service Provider(s) and ensure the performance GWSCCL shall make payments to the Service Provider.
18. The MSI shall be required to submit a detailed installation report post installation of all the equipment at approved locations. The report shall be utilized during the acceptance testing period of the project to verify the actual quantity of the equipment supplied and commissioned under the project.

2.12 Hosting Services

1. The infrastructure of Data Center for ICCC, ATCS and City Surveillance system shall be hosted in the Data Centre to be installed in GWSCCL premises. The following services shall be provisioned by DC
 - a. Internet Bandwidth
 - b. Hosting Space
 - c. Power & Cooling
 - d. Secured Data Center Environment
2. The MSI need to do the sizing of rack space required at facilities based on its capacity planning and sizing for the entire duration of the contract with adequate space for future expansion.

All the requisite consumables like tapes, hard disks, etc. for backup shall be provided by the MSI as per the project requirements. All the tapes, hard disks, etc. once deployed for the project will become property of WSCCL including corrupted/damaged devices

2.13 IT Infrastructure at Viewing Center, Interim ICCC, ICCC and DC

It is proposed that the MSI shall provide the IT hardware infrastructure at the DC for successful operations of the systems. The DC will be hosted at GWMC. The ICCC has been envisaged to be established in GWMC. Another CCC will be set-up at Police Commissioner Head Quarters for Law & Order, Surveillance and Traffic Management

Floor plan is annexed to the RFP in Annexure V.

Bidder to visit the site for exact location and space availability survey.

Indicative BoQ is provided in Volume 1 Section 7.9

Note: Interim Command Center (Secondary CCC) to be built at CP Head Quarters will also carry the same BoQ in the above table. However the dimensions of the floor space varies and bidder is required to provision for the variance suitable after due site survey.

1. MSI has to ensure that redundancy is provided for all the key components to ensure that no single point of failure affects the performance of the overall system. It will be MSI's responsibility to:
 - a. Supply, Install and Commission of IT Infrastructure including site preparation in ICCC.
 - b. Supply viewing screen, workstations, IP Phones, network switch, and required accessories including furniture at viewing centers. At RTC Warangal.
2. Along with ICCC, the following systems shall also be available for monitoring at the Command center in CP Head Quarters:
 - a. Video feeds from field CCTV cameras
 - b. Live report on the status of Junctions and traffic signals
 - c. Video feed of Bus Transit system will be available at RTC Warangal
3. The MSI shall establish a state of the art ICCC, the key components of the ICCC will be as follows:
 - a. Video Wall system
 - b. Operator workstations
 - c. IP Phones
 - d. Active Networking Components (Switches, Routers)
 - e. Passive Networking Components
 - f. Electrical Cabling and Necessary LED Illumination Devices for approximately 5000 Square feet area
 - g. Office Workstations
 - h. UPS (1 hour backup)
4. The MSI shall also establish monitoring stations at viewing center in Warangal RTC Hanamkonda HQ, the key components of the viewing centers will be as follows:
 - a. LED display screens
 - b. Operator workstations
 - c. IP Phones
 - d. UPS (1 hour backup)
 - e. Furniture and fixtures, if required

2.14 Network and server racks for hosting Data Centre Infrastructure

- a) Data Centre developed by MSI should be as per Telecommunications Infrastructure Standard for Data Centers
- b) The MSI shall provide system integration services to customize and integrate the applications procured through the project. The ITMS and surveillance system applications proposed by the MSI should have open APIs and should be able to integrate and share the data with other third party systems already available or coming up in the near future
- c) As part of preparing the final bill of material for the data center, the successful MSI will be required to list all passive & active components required in the data center.
- d) The bill of material proposed by the successful MSI will be approved by GWSCCL for its supply and installation. Indicative IT Infrastructure to be commissioned as part of the ATCS and City Surveillance System project at Data Centre are as under:
- e) Servers (inclusive of OS) - Application Servers, Database Server, Video Recording Server, Video Management Server, Enterprise Backup Server, Domain Controller, Failover Servers for application and Recording Servers
- f) Application & System Software (with necessary customization) –Traffic Controller System application, Video Management System application, ANPR application, Red Light Violation Detection application, application, Variable message Sign Board application, Traffic Violation cameras application, and E-Challan application. The MSI shall ensure that the applications are Cloud ready.
- g) RDBMS (if required)
- h) Anti-virus Software
- i) EMS software
- j) Primary Storage Solution
- k) Storage Management Solution
- l) Switches
- m) KVM Switches
- n) Firewall
- o) IP Phones
- p) Racks
- q) All required Passive Components
- r) Any other Server required to the cater to the scope of work mentioned in this

The MSI shall be required to submit a detailed installation report post installation of all the equipment at approved locations. The report shall be utilized during the acceptance testing period of the project to verify the actual quantity of the equipment supplied and commissioned under the project

2.15 Disaster Recovery

1. MSI shall propose to host Applications and storage on cloud for complete Data Recovery (DR) operations. Applications should fail-over to the cloud in case of DR. The MSI would have to Design the DR according to RTO/RPO and consider active/active and active/passive.
2. DR shall be implemented based on managed cloud services and shall adhere to guideline issued by MeitY over time to time. SLA for DR shall be as per MeitY guideline.
3. MSI may propose the Cloud Service Provider from the empaneled vendors of Deity.
4. Below are the key factors to be considered for cloud hosting -
 - a. The MSI is required to prepare and submit along with their technical proposal, the details of methodologies and computations for sizing and capacity of storage, compute, backup, network and security.
 - b. There should be logical separation (of space, servers, storage, network infrastructure and networks) to protect data, applications and servers on Private cloud.

It is expected that bidder will make all necessary provision to ensure high availability at the Data Centre and after switch over to the DR; it gets back in to normal operations from the DC as soon as possible. However, the overall disaster Recovery Solution should be provisioned in such a manner that previous 7 days video feeds are available and it should be able to run for 7 Days in case of Disaster.

One full-scale DR drill to be conducted after go-live and additional DR Drills on annual basis shall be conducted.

1. The system will be hosted in the site identified by the MSI and as agreed by the GWSCCL for DR (backup only).
2. There should be sufficient capacity (compute, network and storage capacity offered) available for near real time provisioning (as per the SLA requirement of the GWSCCL) during any unanticipated spikes in the user load.
3. DR site will be located in India only.
4. Ensure redundancy at each level
5. MSI shall provide interoperability support with regards to available APIs, data portability etc. for the GWSCCL to utilize in case of Change of cloud service provider, migration back to in-house infrastructure, burst to a different cloud service provider for a short duration or availing backup or DR services from a different service provider.
6. The MSI is fully responsible for tech refreshes, patch management and other operations of infrastructure that is in the scope of the MSI.

7. GWSCCL retains ownership of all virtual machines, templates, clones, and scripts/applications created for the GWSCCL's application. GWSCCL retains the right to request (or should be able to retrieve) full copies of these virtual machines at any time
8. Provide a robust, fault tolerant infrastructure with enterprise grade SLAs with an assured uptime of 99.5%, SLA measured at the VM Level & SLA measured at the Storage Levels
9. Cloud services should be accessible via internet and MPLS.
10. Required Support to be provided to the GWSCCL in migration of the VMs, data, content and any other assets to the new environment created by the GWSCCL or any Agency (on behalf of the GWSCCL) on alternate cloud service provider's offerings to enable successful deployment and running of the GWSCCL's solution on the new infrastructure.
11. The MSI should configure, schedule and manage backups of all the data including but not limited to files, folders, images, system state, databases and enterprise applications
 - a. Perform and store data and file backups consisting of an initial full back up with daily incremental backups for files;
 - b. For the files, perform weekly backups;
 - c. For the databases, perform a twice weekly full database backup, with a three times daily backup of database log files
 - d. Encryption of all backup files and data and management of encryption keys as a service that can be enabled for Government Departments that require such a service.
 - e. Retain database backups for thirty (30) days
12. The MSI should offer dashboard to provide visibility into service via dashboard.
13. MSI shall not delete any data at the end of the agreement (for a maximum of 45 days beyond the expiry of the Agreement) without the express approval of the GWSCCL

2.15.1 Preparation of Disaster Recovery Operational Plan

The bidder should provide detailed operating procedures for each application during the following scenarios. These will be mutually agreed upon with Authority during the project kick off.

- Business as usual: the primary site is functioning as required, procedures for ensuring consistency of data availability at secondary site.
- Disaster: Declaration of disaster, making the DR site live for production, ensuring availability of users to the secondary site.

Operations from DR site: Ensuring secondary site is addressing the functionality as desired.

Functional Specification of DR are provided in the next section.

2.16 Configure proposed solution for usage

The service provider shall provide DR Management Solution to Authority meeting following specifications:

#	Features
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1	The proposed solution must offer a workflow based management & monitoring and reporting capability for the real time monitoring of a DR solution parameters like RPO (at DB level), RTO, replication status and should provide alerts (including SMS and e-mail alerts) on any deviations. The proposed solution should be able to conduct DR Drills from a centralized location
2	The proposed solution should provide a single dashboard to track DR Readiness status of all the applications under DR
3	The proposed solution should be capable of reporting important health parameters like disk space, password changes, file addition/deletion etc. to ensure DR readiness
4	The proposed solution should have inbuilt ready to use library of recovery automation action for heterogeneous databases and replication environment. This must significantly reduce custom development of scripts and speedy deployment of DR solutions
5	The proposed solution should facilitate out-of-the-box, workflow based switchover and switchback for DR drills for standard applications based on industry best practices
6	The proposed solution should facilitate workflows for bringing up the applications and all the components it depends on at DR while it is up at primary site without pausing/stopping the replication
7	The proposed solution should be able to manage hosts by either deploying agents or without deploying any agent and should not require any change in the existing environment
8	The proposed solution must support all major platforms including Linux, Windows, Solaris, HP-UX, and AIX with native high availability options. It must support both physical and virtual platforms
9	The proposed solution should facilitate workflow based, single-click recovery mechanism for single or multiple applications
10	The proposed DRM solution should integrate seamlessly with the existing setup without the need to reconfigure or remove existing application setup including clusters
11	The proposed solution should cover all the functionalities mentioned in the specifications and all the required licenses should be provisioned

2.16.1 Periodic Disaster Recovery Plan Update

The service provider shall be responsible for –

- Devising and documenting the DR policy discussed and approved by Authority.

Providing data storage mechanism with from the Go-Live date till the date of contract expiry for the purpose of compliance and audit

3 Annexure I- Functional Requirements & Technical Specifications

3.1 Surveillance System – Functional Requirement

Functional Requirement of the overall Surveillance System can be categorized into following components:

1. Information to be Captured by Edge Devices Information to be analysed at Interim ICCC/ICCC
2. Role Based Access to the Entire System
3. Storage / Recording Requirements
4. Other General Requirements

3.1.1 Information to be captured by Edge Devices

Surveillance Cameras being one of the core sub modules of Area Traffic Control System & City Surveillance project, it is important that their selection and placement is carefully done to ensure the full coverage of the traffic junction along with all associated junction arms, accuracy of the information captured on the field and they are rugged, durable & compact. These cameras need to work on 24 X 7 basis and transmit quality video feeds to the ICCC and would capture the video feeds at 18 FPS during entire duration of day. However, Police may take the regular review of the requirements for video resolution, FPS and may change these numbers to suit certain specific requirements (for example, there could be a situation when certain cameras are required to be viewed at higher FPS for specific period. It is estimated that not more than 5% of the cameras would be required to be viewed at higher FPS at a given point of time). Video feeds will be stored at 18 FPS for a minimum of 30 days at the Data Centre.

3.1.2 Information to be analyzed at /ICCC and Viewing center

The proposed Video Management System should provide a complete end-to-end solution for security surveillance application. The control centre shall allow an operator to view live / recorded video from any surveillance camera on the IP network. The combination of control centre and the IP network would create a virtual matrix, which would allow switching of video streams around the system.

It has been envisaged that all surveillance cameras would not be simultaneously viewed at ICCC. The viewing shall vary from time to time which will help to manage traffic at the junctions and coordinate with the field police officers.

The Department may require additional viewing centers at each Police station in future. The current system must be scalable and interoperable with the future requirements.

3.1.3 Role Based Access to the Entire System

Various users should have access to 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. Other minimum features required in the role based authentication systems are as follows:

- a. The management module should be able to capture basic details (including mobile number & email id) of the Police Personnel & other personnel requiring Viewing / Administration rights to the system. There should be interface to change these details, after proper authentication.
- b. Rights to different modules / sub-modules / functionalities should be role based and proper log report should be maintained by the system for such access.
- c. The system should be with login name & password enabled to ensure that only the concerned personnel are able to login into the system
- d. There should be provision to specify hierarchy of operators / officers for control of the cameras from various locations.
- e. The number of users shall increase as per phase wise implementation. MSI is expected to estimate and provision the same based on the phase wise requirements.
- f. Windows Active Directory/LDAP or any such system can be used to design role based access.

3.1.4 Storage/Recording Requirements

It is proposed that the storage solution shall be modular enough to ensure compliance to the changes in storage / recording policy, to be evolved upon initial deployment of the system. The following storage requirements shall be fulfilled by the MSI as scope for the project:

- a. The Data Centre (DC) will be hosted at GWMC in Warangal
- b. 30 days storage of all the surveillance camera feeds to be stored at Data Centre and Flagged data (critical incidents) will be stored for approximately 90 days, permanent storage envisaged on secondary/backup storage
- c. 90 days storage for all traffic enforcement systems including RLVD, Speed Violation Detection, Traffic violation cameras and ANPR camera at Data Centre.
- d. 365 days storage of traffic junction data for Area Traffic Control System at Data Centre and Flagged data will be stored for approximately 4 years.
- e. Above systems except ATCS are required to be stored on Primary storage for 7 days & on Secondary Storage for remaining days respectively at Data Centre.
- f. For ATCS, Primary storage will be for 90 days and Secondary Storage for 275 days. Back up storage for 4 Years approximately.
- g. Data on storage would be over-written automatically by newer data after the stipulated time period. If some data is flagged by police personnel (or by designated personnel) as important data / evidence data due to some reporting of crime or accident in the area or due to court order or due to suspicious activity, it would need to be stored for longer duration, as per requirements. Police

would analyse such flagged data every 3months to take such decisions for preservation of the flagged data beyond 90 days.

- h. Full audit trail of reports to be maintained for 90 days.
- i. Bidder is expected to carry out the storage requirement estimation and supply as per the solution proposed.
- j. Archival/Backup to be done on NAS / Scale-out NAS / SAN / Unified or equivalent storage solution
- k. Retrieval time for any data stored on secondary storage should be max. 4 hours for critical data & 8 hours for other data.
- l. The recording servers / system, once configured, shall run independently of the Video Management system and continue to operate in the event that the Management system is off-line.
- m. The system shall support the use of separate networks, VLANs or switches for connecting the cameras to the recording servers to provide physical network separation from the clients and facilitate the use of static IP addresses for the devices.
- n. The system shall support H.264 or better, MPEG-4 and MJPEG compression formats for all analog cameras connected to encoders and all IP cameras connected to the system.
- o. The system shall record the native frame rate and resolution supplied by the camera or as configured by the operator from the system administration server.
- p. The system should not limit amount of storage to be allocated for each connected device.
- q. The on-line archiving capability shall be transparent and allow Warangal Police to browse and archive recordings without the need to restore the archive video to a local hard drive for access.
- r. The system shall allow for the frame rate, bit rate and resolution of each camera to be configured independently for recording. The system shall allow the user to configure groups of cameras with the same frame rate, bit rate and resolution for efficient set-up of multiple cameras simultaneously.
- s. The system shall support archiving or the automatic transfer of recordings from a camera's default database to another location on a time-programmable basis without the need for user action or initiation of the archiving process. Archiving shall allow the duration of the camera's recordings to exceed the camera's default database capacity. Archives shall be located on either the recording server or on a connected network drive. If the storage area on a network drive becomes unavailable for recording the system should have the ability to trigger actions such as the automatic sending of email alerts and sound alerts to necessary personnel.
- t. Bandwidth optimisation
 - o The Recording Server / System shall offer different codec (H.264, MJPEG, MPEG-4, etc.) and frame rate (CIF, 4CIF, QCIF, QSD, SD) options for managing the bandwidth utilisation for live viewing on the Client systems. (through use of multiple systems such as transcoding server)
 - o From the Police, the user shall have the option of having video images continually streamed or only updated on motion to conserve bandwidth between the Client systems and the Recording Server.
- u. The Recording Server / System shall support camera (analogue and IP cameras) devices from various manufacturers.

- v. The Recording Server / System shall support the PTZ protocols of the supported devices listed by the camera OEMs.
- w. The system shall support full two-way audio between Client systems and remote devices. (Audio from certain set of cameras can be recorded in future).
- x. Failover Support
 - o The system shall support automatic failover for recording servers. This functionality shall be accomplished by failover server as a standby unit that shall take over in the event that one of a group of designated recording servers fails. Recordings shall be synchronized back to the original recording server once it is back online.
 - o The system shall support multiple failover servers for a group of recording servers.
- y. SNMP Support
 - o The system shall support Simple Network Management Protocol (SNMP) in order for third-party software systems to monitor and configure the system.
 - o The system shall act as an SNMP agent which can generate an SNMP trap as a result of rule activation in addition to other existing rule actions.

3.1.5 Other General Requirements

1. Management/Integration functionality

- a. The Surveillance System shall offer centralised management of all devices, servers and users.
- b. The Surveillance System should not have any limit on the number of cameras to be connected for Surveillance, Monitoring and recording. Any increase in the no. of cameras should be possible by augmentation of Hardware components.
- c. The Surveillance System should have ability to knit the video streams from multiple cameras, based on the date/time stamp. Every video stream shall have date, time, source camera location, FPS etc. water-marked. These attributes shall be finalised at the System Design time. There shall be a centralised NTP server, from which all devices shall synchronise the date and time.
- d. The Surveillance System shall support distributed viewing of any camera in the system using Video walls or big screen displays.
- e. The Surveillance System shall support alarm management. The alarm management shall allow for the continuous monitoring of the operational status and event-triggered alarms from system servers, cameras and other external devices.
- f. It should be possible to integrate the Surveillance System with 3rd-party software, to enable the users to develop customized applications for enhancing the use of video surveillance solution. For e.g., integrating alarm management to initiate SMS, E-Mail, VoIP call etc.
- g. It should be possible to integrate social media platforms to Surveillance System to enable Warangal Police to track and monitor certain trending incident or crime.

- h. The Management system shall store the overall network elements configuration in central database, either on the management server computer or on a separate DB Server on the network.
- i. System should be able to be integrated with Event Management / Incident Management System.
- j. Should be integrated with ICCC solution
- k. Should integrate and share alerts from existing systems Like Dial 100 for sharing alerts and other related information on Incidents

2. System Administration functionality

- a. The System Administration Server shall provide a feature-rich administration client for system configuration and day-to-day administration of the system
- b. The System Administration Server shall support different logs related to the Management Server
 - The System Log
 - The Audit Log
 - The Alert Log
 - The Event Log

3. Rules

The system shall support the use of rules to determine when specific actions occur. Rules shall define what actions shall be carried out under specific conditions. The system shall support rule initiated actions such as:

- Start and stop recording
- Set non-default live frame rate
- Set non-default recording rate
- Start and stop PTZ patrolling
- Send notifications via email

Pop-up video on designated Client Monitor recipients

4. Client System

- a. The Client system shall provide remote users with rich functionality and features as described below.
- b. Viewing live video from cameras on the surveillance system
- c. Browsing recordings from storage systems
- d. Creating and switching between multiple of views.
- e. Viewing video from selected cameras in greater magnification and/or higher quality in a designated hotspot.
- f. Controlling PTZ cameras.
- g. Using digital zoom on live as well as recorded video.

- h. Using sound notifications for attracting attention to detected motion or events.
- i. Getting quick overview of sequences with detected motion.
- j. Getting quick overviews of detected alerts or events.
- k. Quickly searching selected areas of video recording for motion (also known as Smart Search).

5. Remote Web Client

The web-based remote client shall offer live view of up to 16 cameras, including PTZ control and event / output activation. The Playback function shall give the user concurrent playback of multiple recorded videos with date, alert sequence or time searching.

- a. User Authentication – The Remote Client shall support logon using the user name and password credentials

6. Matrix Monitor

- a. Matrix Monitor – The Matrix Monitor feature shall allow distributed viewing of multiple camera on the system on any monitor
- b. The Matrix Monitor feature shall access the H.264/MJPEG/MPEG4 stream from the connected camera directly and not sourced through the recording server

7. Alarm Management Module

- a. The alarm management module shall allow for continuous monitoring of the operational status and event-triggered alarms from various system servers, cameras and other devices. The alarm management module shall provide a real-time overview of alarm status or technical problems while allowing for immediate visual verification and troubleshooting.
- b. The alarm management module shall provide interface and navigational tools through the client including;
 - o Graphical overview of the operational status and alarms from servers, network cameras and external devices including motion detectors and access control systems.
 - o Intuitive navigation using a map-based, hierarchical structure with hyperlinks to other maps, servers and devices or through a tree-view format.
- c. The module shall include flexible access rights and allow each user to be assigned several roles where each shall define access rights to cameras.
- d. Basic VMS should be capable to accept third party generated events / triggers
- e. Based on alarms/alerts, customised/standard alert messages should be published on VMB/PA, after authorisation by a supervisor/operator.

8. Other Miscellaneous Requirements

- a. System should have a facility to create CDs or other storage media for submission to Judiciary, which can be treated evidence for legal matters. Such storage media creation should be tamper proof and MSI to provide appropriate technology so that integrity and quality of

evidence is maintained as per requirements of the judiciary. Bidder is required to specify any additional hardware / software required for this purpose & the same can be listed in miscellaneous section of the commercial bid. MSI will also prepare the guideline document to be followed by the Police Personnel for the retrieval of Video / images from the CCTV System so as to maintain integrity of the evidence. Such a guideline document should include methods of retrieval of data, check-list to be followed and flowchart of the entire process to be followed.

- b. All the systems proposed and operationalisation of Video Management System should comply with requirements of IT Acts.
- c. Any hardware or software required to achieve the functional requirement and technical solution of the overall Project (may not be not specified in the schedule) is to be proposed in the Bid and borne by the MSI.
- d. Bidder shall be required to provide a standardized Mobile Application to integrate smart phones and tablets for 2-way communication with the Surveillance System in a secure manner. Police may provide such tablets / smart phones to the designated Police Personnel. It will be responsibility of MSI to configure such tablets / Smartphone, for the Surveillance System being implemented a part of this project, and ensure that all the necessary access is given to these mobile users. Functionalities to be provided through mobile application: Viewing of any video steam from Central VMS, uploading of video / pictures central VMS, Location based GIS Map access, tagging of mobile device/location information for all relevant functionalities.

Police reserves the right to appoint any Independent Evaluation Agency at any time during the phases of the project.

All specifications provided here-in are minimum specifications which the MSI is required to comply with. However, MSI can propose solution with better specifications while designing their overall solution.

3.2 Surveillance System – Technical Specifications

3.2.1 PTZ Cameras

#	Parameters	Minimum Specifications or better	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make	<to be provided by the bidder>		
2.	Model	<to be provided by the bidder>		
3.	Video Compression	H.264		
4.	Video Resolution	1920 X 1080		
5.	Frame rate	Min. 25 fps		

6.	Image Sensor	1/3" OR ¼" Progressive Scan CCD / CMOS		
7.	Lens	Auto-focus, 4.3 - 129 mm (corresponding to 30x)		
8.	Minimum Illumination	Colour: 0.5 lux, B/W: 0.1 lux (at 30 IRE)		
9.	Day/Night Mode	Colour, Mono, Auto		
10.	S/N Ratio	≥ 50Db		
11.	PTZ	Pan: 360° endless/continuous, 0.2 to 300°/s (auto), 0.2 to 100°/s (Manual) Tilt: 90°, 0.2 to 100°/s (Auto), 0.2 to 40°/s (Manual) 30x optical zoom and 10x digital zoom 64 preset positions Auto-Tracking Pre-set tour		
12.	Auto adjustment + Remote Control of Image settings	Colour, brightness, sharpness, contrast, white balance, exposure control, backlight compensation, Gain Control, Wide Dynamic Range		
13.	Protocol	HTTP, HTTPS, FTP, RTSP, RTP, TCP, UDP, RTCP, DHCP, UPnP, QoS, IPV4, IPV6, ONVIF Profile S		
14.	Security	Password Protection, IP Address filtering, User Access Log, HTTPS encryption		
15.	Operating conditions	0 to 50°C (temperature), 50-90% humidity		
16.	Casing	NEMA 4X / IP-66 rated		
17.	Certification	UL/EN,CE,FCC		
18.	Local storage	Minimum 64 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. 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.		
19.	IR	Internal/External. IR range should be 100 mtr or better		

3.2.2 Fixed Box Cameras

#	Parameter	Minimum Specifications or better	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make	<to be provided by the bidder>		
2.	Model	<to be provided by the bidder>		
3.	Video Compression	H.264		
4.	Video Resolution	1920 X 1080		
5.	Frame rate	Min. 30 fps		
6.	Image Sensor	1/3" Progressive Scan CCD / CMOS		
7.	Lens Type	Varifocal, C/CS Mount, IR Corrected Full HD		
8.	Lens#	Auto IRIS 5~50mm/ 8 – 40 mm, F1.4		
9.	Minimum Illumination	Colour: 0.5 lux, B/W: 0.1 lux (at 30 IRE)		
10.	IR Cut Filter	Automatically Removable IR-cut filter		
11.	Day/Night Mode	Colour, Mono, Auto		
12.	S/N Ratio	≥ 50 Db		
13.	Auto adjustment + Remote Control of Image settings	Colour, brightness, sharpness, contrast, white balance, exposure control, backlight compensation, Gain Control, Wide Dynamic Range		

14.	Local storage	Minimum 64 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. 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.		
15.	Protocol	IPV4, IPV6, HTTP, HTTPS, FTP/SMTP, NTP, RTSP, RTP, TCP, UDP, RTCP, DHCP, UPnP, QoS, ONVIF Profile S		
16.	Security	Password Protection, IP Address filtering, User Access Log, HTTPS encryption		
17.	Operating conditions	0 to 50°C (temperature), 50 to 90% (humidity)		
18.	Intelligent Video	Motion Detection & Tampering alert		
19.	Alarm I/O	Minimum 1 Input & 1 Output contact for 3rd part interface		
20.	Casing	NEMA 4X / IP-66 rated, IK10		
21.	Certification	UL/EN, CE,FCC		

3.2.3 ANPR System

The ANPR System shall enable monitoring of vehicle flow at strategic locations. The system shall support real-time detection of vehicles at the deployed locations, recording each vehicle, reading its number plate, database lookup from central server and triggering of alarms/alerts based on the vehicle status and category as specified by the database. The system usage shall be privilege driven using password authentication

#	Description	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make	<to be provided by the bidder>	
2.	Model	<to be provided by the bidder>	

<p>3.</p>	<p>Vehicle Detection by Color</p> <ul style="list-style-type: none"> • The system shall detect the color of all vehicles in the camera view during daytime and label them as per the predefined list of configured system colors. The system will store the color information of each vehicle along with the license plate information for each transaction in the database. • The system shall have options to search historical records for post event analysis by the vehicle color or the vehicle color with license plate and date time combinations 		
<p>4.</p>	<p>Alert Generation</p> <ul style="list-style-type: none"> • The system should have option to input certain license plates according to the hot listed categories like "Wanted", "Suspicious", "Stolen", etc by authorized personnel. • The system should be able to generate automatic alarms to alert the control room personnel for further action, in the event of detection of any vehicle falling in the hot listed categories. 		
<p>5.</p>	<p>Vehicle Status Alarm Module</p> <ul style="list-style-type: none"> • On successful recognition of the number plate, system should be able generate automatic alarm to alert the control room for vehicles which have been marked as "Wanted", "Suspicious", "Stolen", "Expired". (System should have provision/expansion option to add more categories for future need). • The Instantaneous and automatic generation of alarms. In case of identity of vehicle in any category which is define by user. 		

<p>6.</p>	<p>Vehicle Log Module</p> <ul style="list-style-type: none"> • The system shall enable easy and quick retrieval of snapshots, video and other data for post incident analysis and investigations. • The system should be able to generate suitable MIS reports that will provide meaningful data to concerned authorities and facilitate optimum utilization of resources. These reports shall include. <ul style="list-style-type: none"> ○ Report of vehicle flow at each of the installed locations for Last Day, Last Week and Last Month. ○ Report of vehicles in the detected categories at each of the installed locations for Last Day, Last Week and Last Month. ○ Report of Vehicle Status change in different Vehicle Categories. • The system shall have Search option to tune the reports based on license plate number, date and time, site location as per the need of the authorities. • The system shall have option to save custom reports for subsequent use. The system shall have option to export report being viewed to common format for use outside of the ANPRS or exporting into other systems. • The system should provide advanced and smart searching facility of License plates from the database. There should be an option of searching number plates almost matching with the specific number entered (up to 1 and 2 character distance) 		
<p>7.</p>	<p>Vehicle Category Editor</p> <ul style="list-style-type: none"> • The system should have option to input certain license plates according to category like "Wanted", 		

	<p>"Suspicious", "Stolen", "Expired" etc. by Authorized personnel.</p> <ul style="list-style-type: none"> • The system should have an option to add new category by authorized personnel. • The system should have option to update vehicle status in specific category by authorized personnel. e.g. on retrieval of stolen vehicle, system entry should be changed from "Stolen" to "Retrieved". • System should have option to specify maximum time to retain vehicle records in specific categories. 		
<p>8.</p>	<p>Central Management Module</p> <ul style="list-style-type: none"> • The Central Management Module shall run on the ANPRS Central Server in control booth. It should be possible to view records and edit hotlists from the Central Server. <p>ANPR Specification</p> <ul style="list-style-type: none"> • Base Specification of Fixed Box Cameras (see above) must be part of the ANPR specifications. <p>Camera Housing</p> <ul style="list-style-type: none"> • IP66 standard with sunshield vandal proof Housing 		
<p>9.</p>	<p>Systems requirement</p> <ul style="list-style-type: none"> • Local Server at Intersection: The system must run on a Commercial Off the Shelf Server (COTS). Outdoor IP 66 Quad core processor based server should be able to cover at least 8 lanes. Temperature rating of the server should be at least 60 degree. • Operating system: The system must be based on open platform and should 		

	run on Linux or windows Operating system. <ul style="list-style-type: none"> • Workstation: Workstation must run on latest available OS. 		
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3.2.4 IR Illuminators (not in scope of Surveillance)

The infrared illuminators are to be used in conjunction with the Fix Box / PTZ cameras specified above to enhance the night vision-

#	Parameter	Minimum Specifications or better	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make	<to be provided by the bidder>		
2.	Model	<to be provided by the bidder>		
3.	Range	Min. 100 meters, with adjustable angle to cover the complete field of view at specified locations		
4.	Minimum Illumination	High sensitivity at Zero Lux		
5.	Power	Automatic on/off operation		
6.	Casing	NEMA 4X / IP-66 rated		
7.	Operating conditions	-0° to 50°C		
8.	Certification	UL/EN/CE/FCC		

3.2.5 Network Video Recorder

#	Parameter	Minimum Specifications or better	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make	<to be provided by the bidder>		
2.	Model	<to be provided by the bidder>		
3.	Input	8 channel IP camera inputs		
4.	Output	1 VGA, 1 HDMI		
5.	Support for Two way Talk	1 channel Input, 1 channel Output		
6.	OSD	Camera title, Time, Video loss, Camera lock, Motion detection, Recording		

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7.	Video/Audio Compression	H.264 / MJPEG / PCM		
8.	Resolution	1080P (1920×1080) / 720P(1280×720) / D1 (704×576 / 704×480)		
9.	Record Rate	25 FPS@1080P for each channel		
10.	Bit Rate	48~8192Kb/s		
11.	Record Mode	Manual, Schedule(Regular(Continuous), MD, Alarm), Stop		
12.	Record Interval	1~120 min (default: 60 min), Pre-record: 1~30 sec, Post-record: 10~300 sec		
13.	Search Mode	Time/Date, Alarm, MD & Exact search (accurate to second), Smart search		
14.	Playback Functions	Play, Pause, Stop, Rewind, Fast play, Slow play, Next file, Previous file, Next camera, Previous camera, Full screen, Repeat, Shuffle, Backup selection, Digital zoom		
15.	Ethernet	RJ-45 port (10/100/1000M)		
16.	Network Functions	TCP/IP, UDP, DHCP, DNS, IP Filter, PPPOE, DDNS, FTP, Email, Alarm Server		
17.	Internal HDD	Minimum 2 HDD slots with each capacity of 4TB with RAID 0 (mirroring) support.. Should be provided with appropriate storage to meet the functional requirements.		
18.	USB	Minimum 2 port		
19.	Working Environment	0°C to 50°C / 0% to 90% RH		
20.	Certification	UL/EN, CE, FCC		
21.	Protocol	ONVIF		

3.2.6 Field Junction Box

#	Parameter	Minimum Specifications	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make	<to be provided by the bidder>		
2.	Model	<to be provided by the bidder>		
3.	Size	Suitable size as per site requirements to house the field equipment		
4.	Cabinet Material	GI with powder coated		
5.	Material Thickness	Min 1.2mm		
6.	Number of Locks	Two		
7.	Protection	IP 55, Junction Box design should ensure to keep the temperature within suitable operating range for equipment's and should also avoid intentional water splash and dust intake		
8.	Mounting	On Camera Pole / Ground mounted on concrete base		
9.	Form Factor	Rack Mount/DIN Rail		
10.	Other Features	Rain Canopy, Cable entry with glands, proper earthing and Fans/any other accessories as required for operation of equipment's within junction box.		

3.2.7 Poles for Camera

#	Parameter	Minimum Specifications	Bidder Compliance (Yes/No)	Product Documentation Reference
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1.	Make	<to be provided by the bidder>		
2.	Model	<to be provided by the bidder>		
3.	Pole type	Hot Dip Galvanized after Fabrication with Silver coating of 86 micron as per IS:2629; Fabrication in accordance with IS-2713 (1980)		
4.	Height	5-10 Meters (or higher), as-per-requirements for different types of cameras & Site conditions		
5.	Pole Diameter	Min. 10 cm diameter pole (bidder to choose larger diameter for higher height)		
6.	Cantilevers	Based on the location requirement suitable size cantilevers to be considered with the pole		
7.	Bottom base plate	Minimum base plate of size 30x30x1.5 cm		
8.	Mounting facilities	To mount RLVD Cameras, ANPR, Speed detection sensors, CCTV cameras, Traffic Signals, Pedestrian Signals, Switch, etc.		
9.	Pipes, Tubes	All wiring must be hidden, through tubes/pipes. No wires shall be visible from outside.		
10.	Foundation	Casting of Civil Foundation with foundation bolts, to ensure vibration free erection (basic aim is to ensure that video feed quality is not impacted due		

		to winds in different climatic conditions). Expected foundation depth of min. 100cms. Please refer to earthing standards mentioned elsewhere in the document.		
11.	Protection	Lightning arrester shall be provided, to protect all field equipment mounted on pole.		

3.2.8 Edge Level Switch (at Traffic Junctions)

#	Parameter	Minimum Specifications	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Port Density & Redundancy	The switch should be rugged outdoor DIN rail mountable 8 ports 10/100/1000TX PoE+(min. 4 Port IEEE802.3at Or 8 Port 802.3af) and with 2 100/1000x SFP ports May require higher port density at some locations, depending upon site conditions		
2.	PoE Standard	IEEE 802.3af/ IEEE 802.3at or better on all ports simultaneously		
3.	Quality of Service	Support for Egress rate limiting, Eight egress queues per port, Voice VLAN, DSCP for IP-based QoS, Differentiated services architecture, IEEE 802.1p Class of Service with strict and weighted round Robin scheduling.		
4.	Multicast support	IGMP Snooping V1, V2, V3		
5.	Management	SNMP V1,V2,V3, Web GUI, CLI, USB or equivalent memory card, IP v6 management feature on open standards, IEEE802.1ag, TDM or equivalent standards		
6.	Security	Should support Access Control Lists (ACLs), DHCP snooping, IEEE802.1x based port authentication, RADIUS, TACACS, SSL, SSH, port mirroring, NTP		
7.	Resiliency	IEEE802.1q, IEEE802.1d, IEEE802.1s, IEEE802.1w, ring resilience/ring protection		

#	Parameter	Minimum Specifications	Bidder Compliance (Yes/No)	Product Documentation Reference
8.	PoE Power per port	Sufficient to operate the CCTV cameras/edge devices connected		
9.	Enclosure Rating	IP 30 or equivalent Industrial Grade Rating(to be housed in Junction box)		
10.	Operating Temperature	0 -60 C or better Industrial Grade Rating		
11.	Safety Certifications	UL/EN/IEC or equivalent, RoHS standards, NEMA –TS2		

3.2.9 Online UPS for field locations

Sr. No	Parameter	Minimum Specifications	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make	<to be provided by the bidder>		
2.	Model	<to be provided by the bidder>		
3.	Capacity	Adequate capacity to cover all above IT Components at respective field locations		
4.	Technology	IGBT based PWM Technology, True Online UPS		
5.	Input Frequency Range	45 to 55 Hz		
6.	Output Frequency Range	45 to 55 Hz		
7.	Output Voltage	220VAC - 230VAC		
8.	Voltage Regulation	+/-2% (or better) and with built-in Over Voltage Cut off facility in the Device		
9.	Frequency	50 Hz +/- 0.1% (free Run Mode)		
10.	Harmonic Distortion (THD)	< 3% (linear load)		
11.	Output Waveform	Pure Sine wave		
12.	Output Power Factor	0.8 or more		
13.	Battery Backup	Adequate and required battery backup to achieve required		

		uptime of field device as well as SLA of the overall solution..		
14.	Battery Type	Lead acid, Sealed Maintenance Free (SMF)		
15.	General Operating Temperature	0 to 50 Degree Celsius		
16.	Alarms & Indications	All necessary alarms & indications essential for performance monitoring of UPS like mains fail, low battery & fault detection		
17.	Bypass	Automatic, Manual Bypass Switch		
18.	Certifications	For Safety & EMC as per international standard		
19.	Overall Protection	IP 55, Junction Box design should ensure to keep the temperature within suitable operating range for equipment's and should also avoid intentional water splash and dust intake		

3.2.10 Video Management System

Video management system shall constitute of a platform which will be designed for viewing, recording and replaying acquired video as part of overall project solution. This platform will be based on the Internet Protocol (IP) open platform concept. Major functionalities are described here

#	Description	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make	<to be provided by the bidder>	
2.	Model	<to be provided by the bidder>	
3.	VMS shall be used for centralized management of all field camera devices, video servers and client users.		
4.	VMS server shall be deployed in a clustered server environment or		

#	Description	Bidder Compliance (Yes/No)	Product Documentation Reference
	support inbuilt mechanism for high availability and failover.		
5.	VMS shall support a flexible rule-based system driven by schedules and events.		
6.	VMS shall be supported for fully distributed solution for monitoring and control function, designed for limitless multi-site and multiple server installations requiring 24/7 surveillance with support for devices from different vendors.		
7.	VMS shall support ONVIF compliant internet protocol (IP) cameras.		
8.	The bidder shall clearly list in their proposal the make and models that can be integrated with the VMS, additionally all the offered VMS and cameras must have Open Network Video Interface Forum (ONVIF) compliance. VMS shall be enabled for any standard storage technologies and video wall system integration.		
9.	VMS shall be enabled for integration with any external Video Analytics Systems both server & edge based.		
10.	VMS shall be capable of being deployed in a virtualized server environment without loss of any functionality.		
11.	All CCTV cameras locations shall be overlaid in graphical map in the VMS Graphical User Interface (GUI). The cameras selection for viewing shall be		

#	Description	Bidder Compliance (Yes/No)	Product Documentation Reference
	possible via clicking on the camera location on the graphical map. The graphical map shall be of high resolution enabling operator to zoom-in for specific location while selecting a camera for viewing.		
12.	VMS shall have an administrator interface to set system parameters, manage codecs, manage permissions and manage storage.		
13.	VMS day to day control of cameras and monitoring on client workstations shall be controlled through the administrator interface.		
14.	Whilst live control and monitoring is the primary activity of the monitoring workstations, video replay shall also be accommodated on the GUI for general review and also for pre- and post-alarm recording display.		
15.	The solution design for the VMS shall provide flexible video signal compression, display, storage and retrieval.		
16.	All CCTV camera video signal inputs to the system shall be provided to various command control center(s), viewing center etc., and the transmission medium used shall best suit the relative camera deployments and access to the CCTV Network.		

#	Description	Bidder Compliance (Yes/No)	Product Documentation Reference
17.	VMS client shall have the capability to work with touch enabled multi-monitor workstations. It shall be capable of displaying videos in up to three (3) monitors simultaneously.		
a.	AVI files		
b.	Motion- Joint Photographic Experts Group (M-JPEG)		
c.	Moving Picture Expert Group-4 (MPEG-4)		
d.	MP4 Export or Latest		
18.	All streams to the above locations shall be available in real-time and at full resolution. Resolution and other related parameters shall be configurable by the administrator in order to provide for network constraints.		
19.	The VMS shall support field sensor settings. Each channel configured in the VMS shall have an individual setup for the following settings, the specific settings shall be determined according to the encoding device:		
20.	The VMS shall support the following operations:		
a.	Adding an IP device		
b.	Updating an IP device		

#	Description	Bidder Compliance (Yes/No)	Product Documentation Reference
c.	Updating basic device parameters		
d.	Adding/removing channels		
e.	Adding/removing output signals		
f.	Updating an IP channel		
g.	Removing an IP device		
h.	Enabling/disabling an IP channel		
i.	Refreshing an IP device (in case of firmware upgrade)		
j.	Multicast at multiple aggregation points		
21.	The VMS shall support retrieving data from edge storage. Thus when a lost or broken connection is restored, it shall be possible to retrieve the video from SD card and store it on central storage. System should support to view the recordings available over cameras local storage device (such as an SD card), and copy them to the server.		
22.	The VMS shall support bookmarking the videos. Thus, allowing the users to mark incidents on live and/or playback video streams.		
23.	The VMS shall allow the administrator to distribute camera load across multiple recorders and be able shift the cameras from one recorder to another by simple drag and drop facility.		

#	Description	Bidder Compliance (Yes/No)	Product Documentation Reference
24.	VMS shall support automatic failover for recording.		
25.	VMS should also support dual recording or mirroring if required.		
26.	VMS shall support manual failover for maintenance purpose.		
27.	VMS shall support access and view of cameras and views on a smartphone or a tablet (a mobile device).		
28.	VMS shall support integration with the ANPR application.		
29.	VMS shall support integration with other online and offline video analytic applications.		
30.	VMS shall be able to accept alerts from video analytics built into the cameras, other third party systems, sensors etc.		

3.2.11 Client System

The Client system shall provide remote users with rich functionality and features as described below:

#	Functionality	Bidder Compliance (Yes/No)
1.	Viewing live video from cameras on the surveillance system.	
2.	Browsing recordings from storage systems.	
3.	Creating and switching between multiple of views.	
4.	Viewing video from selected cameras in greater magnification and/or higher quality in a designated hotspot.	

5.	Using digital zoom on live as well as recorded video.	
6.	Using sound notifications for attracting attention to detected motion or events.	
7.	Getting quick overview of sequences with detected motion.	
8.	Getting quick overviews of detected alerts or events.	
9.	Quickly searching selected areas of video recording for motion (also known as Smart Search).	

3.2.12 Remote Web Client

#	Description	Bidder Compliance (Yes/No)
1.	The web-based remote client shall offer live view of up to 9 cameras, including PTZ control (if applicable) and event / output activation. The Playback function shall give the user concurrent playback of multiple recorded videos with date, alert sequence or time searching.	
2.	User Authentication – The Remote Client shall support logon using the user name and password credentials	

3.2.13 Mobile Client

	Description	Bidder Compliance (Yes/No)
1.	The bidder shall be required to provide a standardised Mobile Application to integrate smart phones and tablets for 2-way communication with the Video Management System in a secure manner. It will be responsibility of MSI to configure such tablets / Smartphone with the Surveillance System and ensure that all the necessary access is given to these mobile users.	
2.	Communication with mobile client and server shall be encrypted with Digital Certificate.	

3.2.14 Matrix Monitor

#	Description	Bidder Compliance (Yes/No)
1.	Matrix Monitor – The Matrix Monitor feature shall allow distributed viewing of multiple cameras on the system on any monitor.	
2.	The Matrix Monitor feature shall access the H.264/MJPEG/MPEG4 stream from the connected camera directly and not sourced through the recording server.	

3.2.15 Alarm Management Module

#	Description	Bidder Compliance (Yes/No)
1.	The alarm management module shall allow for continuous monitoring of the operational status and event-triggered alarms from various system servers, cameras and other devices. The alarm management module shall provide a real-time overview of alarm status or technical problems while allowing for immediate visual verification and troubleshooting.	
2.	The alarm management module shall provide interface and navigational tools through the client including;	
3.	Graphical overview of the operational status and alarms from servers, network cameras and external devices including motion detectors and access control systems.	
4.	Intuitive navigation using a map-based, hierarchical structure with hyperlinks to other maps, servers and devices or through a tree-view format.	
5.	The module shall include flexible access rights and allow each user to be assigned several roles where each shall define access rights to cameras.	
6.	Basic VMS should be capable to accept third party generated events / triggers.	

3.2.16 Management / Integration Functionality

#	Description	Bidder Compliance (Yes/No)
1.	The Surveillance System shall offer centralized management of all devices, servers and users.	
2.	The Surveillance System should not have any limit on the number of cameras to be connected for Surveillance, Monitoring and Recording. Any increase in the no. of cameras should be possible by augmentation of Hardware components.	
3.	The Surveillance System shall support distributed viewing of any camera in the system using Video walls or big screen displays.	
4.	The Surveillance System shall support alarm management. The alarm management shall allow for the continuous monitoring of the operational status and event-triggered alarms from system servers, cameras and other external devices.	
5.	It should be possible to integrate the Surveillance System with 3rd-party software, to enable the users to develop customized applications for enhancing the use of video surveillance solution. For e.g., integrating alarm management to initiate SMS, E-Mail, VoIP call, etc.	
6.	The Management system shall store the overall network elements configuration in central database, either on the management server computer or on a separate DB Server on the network.	
7.	System should be able to be integrated with Event Management / Incident Management System.	

3.2.17 System Administration Functionality

#	Description	Bidder Compliance (Yes/No)
1.	The System Administration Server shall provide a feature-rich administration client for system configuration and day-to-day administration of the system.	
2.	The System Administration Server shall support different logs related to the Management Server. <ul style="list-style-type: none"> • The System Log • The Audit Log • The Alert Log • The Event Log 	
3.	Rules: The system shall support the use of rules to determine when specific actions occur. Rules shall define what actions shall be carried out under specific conditions. The system shall support rule initiated actions such as: <ul style="list-style-type: none"> • Start and stop recording • Set non-default live frame rate • Send notifications via email • Pop-up video on designated Client Monitor recipients 	

#	Description	Bidder Compliance (Yes/No)
1.	System should have a facility to create CDs or other storage media for submission to Judiciary, which can be treated evidence for legal matters. Such storage media creation should be tamper proof and MSI to provide appropriate technology so that integrity and quality of evidence is maintained as per requirements of the judiciary. Bidder is required to specify any additional hardware / software required for this purpose & the same can be listed in Miscellaneous section of the commercial bid. The bidder will also prepare the guideline document to be followed by the Police Personnel for the retrieval of Video / images from the CCTV System so as to maintain integrity of the evidence. Such a guideline document should include	

	methods of retrieval of data, check-list to be followed and flowchart of the entire process to be followed.	
2.	All the systems proposed and operationalization of Video Management System should comply with requirements of IT Acts.	
3.	Security Platform shall have strong security mechanism such as the use of advance encryption/digital certificates/ authentication to ensure that only authorized personnel have access to critical information, prevent man-in-the-middle attacks, and that the data is kept private.	
4.	System should ensure that once recorded, the video cannot be altered, ensuring the audit trail is intact for evidential purposes.	

3.2.18 Major Server components for VMS

Video Management Server(s)	Video Management System Servers will maintain coherent operations between all servers and workstations. It will host Control Center, where the system is administered, and System database. It will monitor one or more Recorder servers on separate dedicated computers, storage devices, IP-compatible devices, and one or more workstation. All network communication will also be is performed via the Video Management servers.
Video Recording Server(s)	The Video Recorder Server will be a dedicated server that will store and processes video with the help of Video Management System
Video Analytics Server (s)	Video Analytics Software will be installed in the Video Analytics Server, Video Analytics is a software product that will analyse live video in real-time to detect, identify, and track objects of interest. It will automatically issue alerts to the appropriate personnel and initiate appropriate follow-up action according to pre-defined rules. This software will also manage sensors; each sensor will monitor a single video feed for security events. The video feeds will be connected over the network to the Video Analytics Server. Sensors on the Video Analytics Server will perform all event detection functions.
Web Server(s)	It will be used to launch the client application remotely through web browsers.
Gateway Server (s) – If required	A Media Gateway server will be used to establish remote connections to review and transcode the video. Standalone Media Gateway servers can also be installed on separate machines. Standalone servers will be recommended for such large systems that will transfer video data to remote clients.

3.3 Area Traffic Control System (ATCS) – Functional Requirement

3.3.1 Traffic Signal Controller

#	Description	Bidder Compliance(Ye s/No)	Product Documentation Reference
1	Make	<to be provided by the bidder>	
2	Model	<to be provided by the bidder>	
3	The Traffic Signal Controller equipment is a 32 bit or 64 bit microcontroller with solid state traffic signal lamp switching module with the ability to program any combination of traffic signal stages, phases and junction groups. The controller will ideally have a conflict monitoring facility to ensure that conflicting, dangerous are pre-flagged at the programming stage and these are disallowed even during manual override phase.		
4	The Traffic Signal Controller can be controlled through the central traffic control center as an individual junction or as part of group of traffic junctions along a corridor or a region. The signal controller design must be flexible for the junction could be easily configured to be part of any corridor or group definition and could be changed through central command controller easily		
5	Site specific configuration data shall be stored in a non-volatile memory device (FLASH memory) easily programmable at the site through keypad or laptop. A minimum of 512KB flash memory and 128KB RAM shall be provided. Volatile memory shall not be used for storing the junction specific plans or signal timings.		
6	All timings generated within a traffic signal controller shall be digitally derived from a crystal clock which shall be accurate to plus or minus 100 milliseconds.		
7	The controller shall provide a real time clock (RTC) with battery backup that set and update the time, date and day of the week from the GPS. The RTC		

	shall have minimum of 10 years battery backup with maximum time tolerance of +/- 2 sec per day.		
8	The controller shall have the facility to update the RTC time from ATCS server, GPS and through manual entry.		
9	The traffic signal system including controller shall have provision for audio output tones and should be disabled friendly.		
10	The controller shall be capable of communicating with the ATCS server through Ethernet on a managed leased line network or any other appropriate stable communication network.		

A. Police Panel

#	Description	Bidder Compliance(Ye s/No)	Product Documentation Reference
1	Four Hurry Call switches: The Hurry Call mode will provide the means to force the controller to a defined stage, without violating safety clearances. A preemption input may be used to demand the Hurry Call mode to give right of way to emergency vehicles. It should be possible to configure the Hurry Call switches to any stage as per site requirements.		
2	One Forced Flash Switch: Activation of this switch should force the signal to Flashing Amber / Flashing Red.		
3	One Auto / Manual Switch: Activation of this switch should enable manual operation of the controller. Deactivation of the manual switch shall continue from the current stage without interruption.		
4	One Manual Advance Pushbutton Switch: In manual operation mode, the stages appear in the sequence specified in the signal plan timetable. Activating the pushbutton switch shall terminate the currently running stage and start the next, without violating safety clearances.		

5	One Junction OFF Switch: Activating this switch should put OFF all signal lamps. On deactivation of the switch the traffic signal controller shall resume its normal operation without violating any safety clearances.		
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B. Modes of Operation

The traffic signal controller shall have the following modes of operation:

#	Description	Bidder Compliance(Years/No)	Product Documentation Reference
1	Fixed Time: In fixed time (pre-timed) mode the traffic signal controller shall execute stage timings according to the site specific timetable maintained in the traffic signal controller FLASH memory. Inputs from vehicle detectors shall be ignored in this mode and no preemption shall be made on any stage. Cycle time remains constant in every cycle execution for a given time period.		
2	Vehicle Actuation with All Stages Preemption: In the vehicle actuation with all stages preemption mode, the traffic signal controller shall execute stage timings as per demand from vehicle detectors within the constraints of Minimum Green, Maximum Green running period for the stage and Cycle time stored in the traffic signal controller FLASH memory. Preemption shall be possible for all demand actuated stages. Cycle time may vary in every cycle execution.		
3	Semi-Actuation: In the semi-actuation mode, the traffic signal controller shall execute stage timings in the vehicle actuated stages as per demand from vehicle detectors within the constraints of Minimum Green, Maximum Green running period for the stage and Cycle time stored in the traffic signal controller FLASH memory. All other stages shall execute the Maximum green time configured for the stage. Preemption shall be possible for all demand		

	actuated stages. Cycle time may vary in every cycle execution.		
4	Stage Skipping: The traffic signal controller shall not execute the stage enabled for skipping when there is no vehicle demand registered for the stage till clearance amber time of the previous stage.		
5	Transit Signal Priority (TSP) for BRT buses: The traffic signal controller shall provide transit signal priority for buses in dedicated lane to ensure minimum stop delay at the intersection, without violating safety clearances.		
6	Vehicle Actuation with Fixed Cycle length: In vehicle actuation with fixed cycle length mode, the traffic signal controller shall execute stage timings as per demand from vehicle detectors within the constraints of Minimum Green, Maximum Green running period for the stage and Cycle time shall be maintained constant during a given timeslot. Preemption for all demand actuated stages except for Priority Stage shall be possible.		
7	<p>Full ATCS (FATCS): In FATCS mode, the traffic signal controller shall execute 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 Computer during every cycle switching. Preemption for all demand actuated stages except Priority Stage shall be possible in this mode. The traffic signal controller 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 vehicle actuated. On restoration of the communication with central computer the traffic signal controller shall automatically resort to FATCS mode.</p> <p>The traffic signal controller shall accept commands for remote selection / de-selection of the following from the Central Computer at Interim ICC/ICCC.</p>		

	<p>Hurry Call</p> <p>Flashing Amber / Flashing Red</p> <p>Junction Off</p> <p>If not reverted to the normal operation within the time period listed below, the traffic signal controllers shall timeout the commands and operate normally</p> <p>Hurry Call – 5 Minutes</p> <p>Flashing Amber / Flashing Red – 30 Minutes</p> <p>Junction Off – 30 Minutes</p> <p>The traffic signal controller shall report the following to the Central Computer through the communication network every cycle or on an event as appropriate.</p> <p>Green time actually exercised for each approach (stage preemption timing) against the Green running period set for the approach by the Central Computer</p> <p>Mode of Operation</p> <p>Lamp failure, if any</p> <p>Output short circuit, if any</p> <p>Detector failure, if any</p>		
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C. Traffic Signal Controller Operating Parameters

Phases - The controller shall have facility to configure minimum 32 Phases either for vehicular movement, filter green, indicative green, pedestrian movement or a combination thereof.

#	Description	Bidder Compliance(Ye s/No)	Product Documentation Reference
1	It shall be possible to operate the filter green (turning right signal) along with a vehicular phase. The filter green signal shall flash for a time period equal to the clearance amber period at timeout when operated with a vehicular phase.		

#	Description	Bidder Compliance(Years/No)	Product Documentation Reference
2	The pedestrian phase signal shall be configured for flashing red or flashing green aspect during pedestrian clearance.		
3	It shall be possible to configure any phase to the given lamp numbers at the site.		
4	Stages – The controller shall have facility to configure 32 Stages		
5	Cycle Plans – The controller shall have facility to configure 24 Cycle Plans and the Amber Flashing / Red Flashing plan. It shall be possible to define different stage switching sequences in different cycle plans. The controller shall have the capability for a minimum of 32 cycle-switching per day in fixed mode of operation.		
6	Day Plans – 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 day plans.		
7	Special Day Plans – The controller shall have facility to configure a minimum of 20 days as special days in a calendar year.		
8	Starting Amber – During power up the controller shall initially execute the Flashing Amber / Flashing Red plan for a time period of 3 Seconds to 10 Seconds. The default value of this Starting Amber is 5 Seconds. Facility shall be available to configure the time period of Starting Amber within the given limits at the site.		
9	Inter-green – Normally the inter-green period formed by the clearance Amber and Red extension period will be common for all stages. However, the controller shall have a facility to program individual inter-green period from 3 Seconds to 10 Seconds.		

#	Description	Bidder Compliance(Years/No)	Product Documentation Reference
10	Minimum Green – The controller shall allow programming the Minimum Green period from 5 Seconds to 10 Seconds without violating the safety clearances. It should not be possible to preempt the Minimum Green once the stage start commencing execution.		
11	All Red – 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.		
12	Signal lamps monitoring – The controller shall have inbuilt circuitry to monitor the lamp status		
13	Green – Green Conflict Monitoring – 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.		
14	Cable less Synchronization – It shall be possible to synchronize the traffic signal controllers installed in a corridor in the following modes of operation, without physically linking them and without communication network. GPS enabled RTC shall be the reference for the cable less synchronization.		
15	Fixed Time mode with fixed offsets		
16	Vehicle Actuated mode with fixed offsets		

D. Input and Output facilities

#	Description	Bidder Compliance(Ye s/No)	Product Documentation Reference
1	Lamp Switching: The controller shall have maximum 64 individual output for signal lamp switching. The signal lamps shall be operating on appropriate DC/AC voltage of applicable rating		
2	Detector Interface: A minimum of 16 vehicle detector inputs shall be available in the controller. All detector inputs shall be optically isolated and provided with LED indication for detection of vehicle For future scalability to ATCS		
3	Communication Interface: The traffic signal controller shall support Ethernet interface to communicate with the ATCS server		
4	Power Saving: The traffic signal controller shall have a facility to regulate the intensity of signal lamps during different ambient light conditions thereby saving energy.		
5	Real-time Clock (RTC): The GPS receiver for updating time, date and day of the week information of the traffic signal controller should be an integral part of the traffic signal controller.		
6	The traffic signal controller shall update the date, time and day of the week automatically from GPS during power ON and at scheduled intervals.		
7	Manual entry for date, time and day of week shall be provisioned for setting the traffic signal controller RTC (Real Time Clock).		
8	It shall be possible to set the RTC from the Central Server when networked		
9	Keypad (optional): The traffic signal controller shall have a custom made keypad or should have provision for plan upload and download using PC/laptop/Central Server		

10	Operator Display (optional): The traffic signal controller shall have a LED backlit Liquid Crystal Display (LCD) as the operator interface.		
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3.3.2 Countdown Timer

Countdown Timer shall be installed at each traffic junction under ITMS & City Surveillance System Project.

#	Description	Bidder Compliance(Yes/No)	Product Documentation Reference
1	Make	<to be provided by the bidder>	
2	Model	<to be provided by the bidder>	
3	Count Down Timer to be configured in Vehicular Mode.		
4	The Vehicular countdown timer should be dual color, <ul style="list-style-type: none"> • Red for Stop or STP • Green color for Go 		
5	There should be alternate Red and Balance phase time for STOP or STP in Flashing		
6	Alternate Green and Balance Phase Time for Go in Flashing		

3.3.3 Communication Network

Function of the Communication network is for remote monitoring of the intersection and its management. Real time data (like RTC time, stage timing, mode, events, etc.) from the traffic signal controller is required to be sent to the Central Computer in Interim ICCC/ICCC and also individual junctions can be controlled and actuated from central ICCC(Hurry Calls, Forced Flash , Junction Switch off, Plan download and upload etc.). The contractor shall clearly specify the bandwidth requirements and the type of network recommended for the ATCS.

The contractor shall specify the networking hardware requirements at the Interim ICCC/ICCC, viewing centre at CP HQ and remote intersections for establishing the communication network.

3.3.4 ATCS Software Application

(This is not currently in the scope of the RFP, However the bidder should ensure that the supplied controller should have this features for being upgraded to ATCS (adaptive mode) in future whenever required by the client)

Objective of the Adaptive Traffic Control Software is to minimize the stops and delays in a road network to decrease the travel time with the help of state-of-the-art technology. The adaptive traffic control system shall operate in real time with the capacity to calculate the optimal cycle times, effective green time ratios, and change intervals for all system traffic signal controllers connected to it. These calculations will be based up on assessments carried out by the Adaptive Traffic Control Software application software running on a Central Computer based on the data and information gathered by vehicle detectors at strategic locations at the intersections controlled by the system.

The Adaptive Traffic Control Software application software shall do the following:

#	Description	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make	<to be provided by the bidder>	
2.	Model	<to be provided by the bidder>	
3.	Identify the critical junction of a corridor or a region based on maximum traffic demand and saturation.		
4.	The critical junction cycle time shall be used as the group cycle time i.e. cycle time common to all intersection in that corridor or region.		
5.	Stage optimization to the best level of service shall be carried out based on the traffic demand.		
6.	Cycle optimization shall be carried out by increasing or decreasing the common corridor cycle time based on the traffic demand within the constraints of Minimum and Maximum designed value of cycle time.		
7.	Offset correction shall be carried out to minimize number of stops and delays along the corridor for the priority route. Offset deviation measured using distance and speed between successive intersections shall be corrected within 5 cycles at a tolerance of +/- 5 seconds maximum.		
8.	The system shall have provision to configure priority for upstream signals as default. The ATCS software shall continuously check the traffic demand for upstream and downstream		

	traffic and automatically assign the priority route to the higher demand direction.		
9.	Develop appropriate stage timing plans for each approach of every intersection under the ATCS, based on real time demand		
10.	Propose timing plans to every intersection under the ATCS in every Cycle		
11.	Verify the effectiveness of the proposed timing plans in every cycle		
12.	Identify Priority routes		
13.	Synchronize traffic in the Priority routes		
14.	Manage and maintain communication with traffic signal controllers under ATCS		
15.	Maintain database for time plan execution and system performance		
16.	Maintain error logs and system logs		
17.	Generate Reports on request		
18.	Graphically present signal plan execution and traffic flow at the intersection on desktop		
19.	Graphically present time-space diagram for selected corridors on desktop		
20.	Graphically present network status on desktop		
21.	Make available the network status and report viewing on Web		
22.	The ATCS shall generate standard and custom reports for planning and analysis		
23.	It shall be possible to interface the ATCS with a popular microscopic traffic flow simulation software for pre and post implementation analysis and study of the proposed ATCS control strategy		
24.	Shall have the ability to predict, forecast and smartly manage the traffic pattern across the		

	signals over the next few minutes, hours or 3-5 days and just in the current real time.		
25.	Shall provide a decision support tool for assessing strategies to minimize congestion, delays and emergency response time to events via simulation and planning tools linked with real time traffic data fusion and control of traffic signaling infrastructure on ground.		
26.	Shall collect continuously information about current observed traffic conditions from a variety of data sources and of different kind (traffic states, signal states, vehicle trajectories, incidents, road works, ...)		
27.	Shall infer a coherent and comprehensive observed traffic state (speeds, vehicular densities, and presence of queues) on all network elements, from abovementioned observations, including vehicle trajectories, through a number of map matching, data validation, harmonization and fusion processes		
28.	Shall extend the measurements made on only a number of elements both on the rest of the unmonitored network, and over time, thus obtaining an estimation of the traffic state of the complete network and the evolution of this traffic state in the future		
29.	Shall forecast the traffic state with respect to current incidents and traffic management strategies (e.g. traffic signal control or variable message signs), improving the decision making capabilities of the operators even before problems occur		
30.	Shall calculate customizable Key Performance Indicators (KPI) to quickly assess the results		
31.	Shall provide calculated traffic flows estimation and forecast, queues and delays to Urban Control and Adaptive Signal Control Systems, allowing for proactive Traffic Management and Control		

32.	Shall generate alerts to the operator that trigger on customizable conditions in the network (starting with simple drops in flow, up to total queue lengths along emission sensitive roads surpassing a definable threshold)		
33.	Shall distribute both collected and calculated traffic information via a variety of communication protocols and channels, ensuring high interoperability degree and thus acting as a “traffic data and information hub”		
34.	Shall create a traffic data warehouse for all historic traffic information gathered from the hardware installed on the road network.		
35.	Shall operate in real time that is continuously updating the estimates on the state of the network and the travel times on the basis of data collected continuously over time.		
36.	Shall operate the traffic lights with the adaptive traffic controls, based on the current and forecasted traffic demand and the current incidents, thus optimizing the green waves continuously throughout the network		
37.	Enable a smart public transport priority respecting the delays for all road users at once with the adaptive signal controller		

E. Reports

System shall generate Corridor based and Intersection based reports. The application software shall generate the following reports, but not limited to the below. All the reports shall be possible for selected dates.

#	Description	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Intersection based reports		
2.	Stage Timing report – The report shall give details of time at which every stage change has taken place. The report shall show the stage		

	sequence, stage timings and stage saturation of all stages of all cycles for a day. The saturation is defined as the ratio between the available stage timings to the actual stage timing executed by the traffic signal controller for the stage (stage preemption time).		
3.	Cycle Timing report – The report shall give details of time at which every cycle has taken place. The report shall show the cycle sequence and cycle timings for all the cycles in a day.		
4.	Stage switching report – The report shall give details of time at which a stage switching has taken place. The report shall show the stage sequence, stage timings and stage saturation for a day.		
5.	Cycle Time switching report – The report shall give details of time at which a cycle switching has taken place. The report shall show the cycle sequence and cycle timings for the cycle in a day.		
6.	Mode switching report – The report shall give details of the mode switching taken place on a day.		
7.	Event Report - The report shall show events generated by the controller with date and time of event.		
8.	Power on & down: The report shall show time when the master is switched on, and last working time of the master controller.		
9.	Intensity Change – The report shall show the brightness of the signal lamp is changed according to the light intensity either manually through keypad or automatically by LDR with time stamp.		
10.	Plan Change – The report shall show the time of change of plan either through keypad or remotely through a PC or Server.		

11.	RTC Failure – The report shall show the time when RTC battery level goes below the threshold value.		
12.	Time Update – The report shall show the time when the Master controller updated its time either manually through keypad, automatically by GPS or through remote server.		
13.	Mode Change – The report shall show the time when Master controller’s operating mode is changed either manually through keypad or a remote server. The typical modes are FIXED, FULL VA SPLIT, FULL VA CYCLE, FLASH, LAMP OFF and HURRY CALL.		
14.	Lamp Status Report – The report shall show lamp failure report with date and time of failure, colour of the lamp and associated phase		
15.	Loop Failure Report – The report shall show the date and time of detector failure with detector number and associated phase.		
16.	Conflict – The report shall show the conflict between lamps (RED, AMBER, GREEN) in the same phase or conflict between lamps with other phase.		
17.	Corridor Performance Report – The report shall show the saturation of all the intersections in a corridor for every cycle executed for the corridor and the average corridor saturation for a day		
18.	Corridor Cycle Time Report – The report shall show the Corridor cycle time, Intersection cycle time, Mode of operation and degree of saturation of all the intersections in a corridor for every cycle for a day		

F. Graphical User Interface

The application software shall have following Graphical User Interface (GUI) for user friendliness

#	Description	Bidder Compliance	Product Documentation Reference
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		(Yes/No)	
1.	User login – Operator authentication shall be verified at this screen with login name and password		
2.	Network Status Display – This online display shall indicate with appropriate colour coding on site map whether an intersection under the ATCS is online or off. On double clicking the intersection a link shall be activated for the traffic flow display for the intersection.		
3.	Traffic Flow Display – This online display shall indicate the current traffic flow with animated arrows, mode of operation, stage number being executed and elapsed stage time.		
4.	Saturation Snapshot – This display shall show the current saturation levels of all intersections in a corridor.		
5.	Reports Printing / Viewing – This link shall allow selection, viewing and printing of different reports available under ATCS		
6.	Time-Space Diagram – The time-space diagram shall display the current stages being executed at every intersection in a corridor with immediate previous history.		
7.	Junctions shall be plotted proportional to their distance on Y-axis and time elapsed for the stage in seconds on X-axis.		
8.	Junction names shall be identified with each plot.		
9.	Facility shall be available to plot the time-space diagram from history.		
10.	Currently running stage and completed stages shall be identified with different colours.		
11.	Stages identified for synchronization shall be shown in a different colour.		

12.	Speed lines shall be plotted for stages identified for synchronization to the nearest intersection in both directions.		
13.	It should be possible to freeze and resume online plotting of Time-Space diagram.		
14.	The system shall have other graphical interfaces for configuring the ATCS, as appropriate.		

3.4 Area Traffic Control System - Technical Specifications

Appropriate controller technology may be chosen to provide the operational levels and accuracy as required for successful function of the ATCS system as per the SLAs defined. The proposed traffic controller shall be disabled friendly and shall also provide audio tones output. The supplied ATC controller should have all the functional capability as mentioned above and also the future scalability to work any of adaptive traffic algorithms available

3.4.1 Traffic Light Aspects

Description		Bidder Compliance(Yes/No)	Product Documentation Reference
1.	Make	<to be provided by the bidder>	
2.	Model	<to be provided by the bidder>	
3.	Key Features:		
a.	lowest power consumption for all colors, maximum 8 watts for each color	BoQ and spec should also describe about led housing	
b.	Meets or exceeds intensity, color and uniformity specifications		
c.	Temperature compensated power supplies for longer LED life		
d.	Uniform appearance light diffusing		
e.	Should be Intertek/ETL/EN compliant		
f.	All units operate at voltage of - 12 / 24 volts DC		
g.	LED shall be single source narrow beam type with clear lens & Luminance uniformity of 1:15		
h.	Pedestrian traffic lights should be provided with clearly audible signals for the benefit of pedestrians with visual impairments		
i.	Phantom Class 5 or equivalent. IP Rating: IP65 and impact resistant to .5kg when dropped from a height of 1300mm		
4.	LED aspects:		
a.	Red, Amber, Green-Full (300 mm diameter) : Hi Flux		
b.	Green-arrow (300 mm diameter): Hi flux		
c.	Animated Pedestrian-Red and Green Animated c/w countdown (300 mm) Hi Brite with diffusions		

5.	LED Retrofit Specifications:		
a.	Power supply:230 Vac +/- 10% and frequency 50+/-5Hz		
b.	Standards: EN 12368 compliant		
c.	Convex Tinted Lens: Available		
d.	Fuse and Transients: Available		
e.	Operating Temperature Range: 0 degree Celsius to 55 degree Celcius Turn Off/Turn On Time: 75 milli seconds max		
f.	Total Harmonic Distortion: <20%		
g.	Electromagnetic interference: Meets FCC Title 47,Subpart B, Section 15 Regulation or equivalent EN/IRC standard		
h.	Blowing Rain/Dust Spec: MIL 810F or Equivalent EN/IRC standard complaint		
i.	Minimum Luminous Intensity (measured at intensity point)(cd): Red 400		
j.	Amber 400		
k.	Green 400		
l.	Dominant Wavelength (nm): Red 630 Amber 590		
m.	Green 490		
n.	Lamp conflict compatibility system: Compatible with lamp failure and conflict detection		

3.4.2 Countdown Timer: this is regular type if required can propose with Graphical type dual color CDT for both Vehicle and Pedestrian

#	Parameters	Minimum Specifications or better	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make	<to be provided by the bidder>		
2.	Model	<to be provided by the bidder>		
3.	CPU	Micro Controller		
4.	Mechanical Specifications			
A	Structural Material	Polycarbonate strengthened against UV rays		
B	Body Color	Light Grey/Black		

C	Dimensions	360mm x 370mm x 220mm		
5.	Display Specification			
A	Lamp Diameter	300mm		
B	Digit Height	150 -165mm		
C	Display Type	Dual Coloured (Red & Green)		
D	No. of Digit	3		
6.	LED Specifications			
A	LED Diameter	5mm LED		
B	Viewing Angle	30°		
C	LED Wave Length	630-640nm (Red), 505nm - 520nm (Blue-Green)		
D	LED Dice Material	AllnGap (Red), InGaN (Blue-Green)		
E	LED Warranty period	5 years		
7.	Technical Features			
A	Power Consumption	20 - 30 Watt Per Lamp		
B	Input Power	85-260V AC, 50Hz		
C	Operating Temperature	-20 to + 60 °C		
D	Humidity	0% to 95% Relative Humidity		
E	Water & Dust Ingress	IP 65		
F	Standard	En12966 Compliant		

3.4.3 Poles for Traffic Signals

Sr. No	Component	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make	<to be provided by the bidder>	

2.	Model	<to be provided by the bidder>		
3.	Material	GI Class 'B' pipe		
4.	Paint	As applicable for Galvanised pole	BOQ	

3.4.4 Cables for Traffic Signals

Sr. No	Component	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make	<to be provided by the bidder>	
2.	Model	<to be provided by the bidder>	
3.	No's of core	7 and 14 core 1.5 sq. mm. 3 Core 2.5 sq. mm.	
4.	Materials	PVC insulated and PVC sheathed armored cable with copper conductor of suitable size as specified in BOQ.	
5.	Certification	ISI Marked	
6.	Standards	Indian Electricity Act and Rules	
7.	IS:1554	PVC insulated electric cables (heavy duty)	

3.5 Traffic Enforcement System – Functional Requirement

3.5.1 Red Light Violation Detection System

#	Description	Bidder Compliance (Yes/No)	Product Documentation Reference
1	Make	<to be provided by the bidder>	
2	Model	<to be provided by the bidder>	
3	General		
a.	The following Traffic violations to be automatically detected by the system by using appropriate Non-Intrusive sensors technology: The system should have both provisions to detect red light status by taking the signal feed from the traffic signal controller as well as by video analytics method using another camera (Evidence Camera) focused at the red light. The Evidence camera should also be used for evidence snap generation. a) Red Light Violation b) Stop Line Violation		
b.	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 data like: a) Type of Violation b) Date, time, Site Name and Location of the Infraction c) Registration Number of the vehicle through ANPR Camera system for each vehicle identified for infraction.		
c.	The system should be equipped with a camera system to record a digitized image and video of the violation, covering the violating vehicle with its surrounding and current state of signal (Red/Green/Amber) by which the system should clearly show nature of violation and proof thereof :- a) When it violates the stop line. b) When it violates the red signal.		

	<p>c) Besides, a closer view indicating readable registration number plate patch of the violating vehicle for court evidence for each violation.</p> <p>The system must have in-built tool to facilitate the user to compose detail evidence by stitching video clips from any IP camera in the junction (including but not limited to the red light violation detection camera, evidence camera), and any other surveillance cameras in the vicinity of the spot of incidence. The entire evidence should be watermarked and encrypted to stand the court of law.</p>		
d.	<p>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.</p>		
e.	<p>The Evidence image produced by the system should be wide enough to give the exact position of the infracting vehicles with respect to the stop line and clearly indicate colour of the Traffic light at the instant of Infraction even if any other means is being used to report the colour of the light.</p>		
f.	<p>The system should interface with the traffic controller to validate the colour of the traffic signal reported at the time of Infraction so as to give correct inputs of the signal cycle.</p>		
g.	<p>The Evidence and ANPR camera should continuously record all footage in its field of view to be stored at the local base station. This should be extractable onto a portable device as and when required. The option of live viewing of evidence cameras from the locations shall be available at the TMC. The network should have the capability to provide the real time feed of the evidence camera to the TMC at the best resolution possible on the available network.</p>		
h.	<p>The system shall be equipped with IR Illuminator to ensure clear images including illumination of the Number Plate and capture the violation image under low light conditions and night time.</p>		

4	Recording & display information archive medium		
a.	The recording and display of information should be detailed on the snapshot of the infracting vehicle as follows:		
b.	Computer generated unique ID of each violation		
c.	Date (DD/MM/YYYY)		
d.	Time (HH:MM:SS)		
e.	Equipment ID		
f.	Location ID		
g.	Carriageway or direction of violating vehicle		
h.	Type of Violation (Signal/Stop Line)		
i.	Lane Number of violating vehicle		
j.	Time into Red/Green/Amber		
k.	Registration Number of violating vehicle		
5	On site-out station processing unit communication & Electrical Interface		
a.	The system should automatically reset in the event of a program hang up and restart on a button press. However the system should start automatically after power failure.		
b.	The system should have secure access mechanism for validation of authorised personnel.		
c.	Deletion or addition and transfer of data should only be permitted to authorised users.		
d.	A log of all user activities should be maintained in the system.		
e.	Roles and Rights of users should be defined in the system as per the requirements of the client		
f.	All formats of the stored data with respect to the infractions should be Non Proprietary.		
g.	The communication between the on-site outstation processing unit housed in the junction box and the detection systems mounted on the cantilever shall be through appropriate secured technology.		
h.	The system should have the capability to transfer the data to Interim ICC/ICCC 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.		

i.	In the event that the connectivity to the Interim ICCC/ICCC 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 on a 24x7 basis.		
6	Mounting structure		
a.	Should be cantilever mounted and shall have minimum 6 Mtrs. height with appropriate vertical clearance under the system from the Road surface to ensure no obstruction to vehicular traffic.		
b.	It should be capable to withstand high wind speeds and for structural safety, the successful bidder has to provide structural safety certificate from qualified structural engineers approved/ certified by Govt. Agency.		
c.	It shall be painted with one coat of primer and two coats of PU paint. The equipment including poles, mountings should have an aesthetic feel keeping in mind the standards road Infrastructure (e.g Poles, Navigation boards etc) currently installed at these locations. The equipment should look “one” with the surroundings of the location and not look out of place.		
d.	Rugged locking mechanism should be provided for the onsite enclosures and cabinets.		
7	RLVD Application		
a.	It should be capable of importing violation data for storage in database server which should also be available to the Operator for viewing and retrieving the violation images and data for further processing. The programme should allow for viewing, sorting, transfer & printing of violation data.		
b.	It 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 closer view indicating readable		

	registration number plate patch of the violating vehicle or its web link on notices for court evidence.		
c.	All outstation units should be configurable using the software at the Central Location.		
d.	Violation retrieval could be sorted by date, time, location and vehicle registration number and the data structure should be compatible with Warangal Police database structure. It should also be possible to carry out recursive search and wild card search.		
e.	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).		
f.	The automatic number plate recognition Software will be part of the supplied system, Success rate of ANPR will be taken as 80% or better during the day time and 60% or better during the night time with a standard number plate.		
g.	The application software should be integrated with the E Challan software for tracing the ownership details of the violating vehicle and issuing/printing notices. Any updates of the software (OS, Application Software including any proprietary software), shall be updated free of cost during the contract period by the MSI.		
h.	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.		
i.	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 SRS) could be Administrator, Supervisor, Officer, Operator, etc.		
j.	Apart from role based access, the system should also be able to define access based on location.		
k.	Rights to different modules / Sub-Modules / Functionalities should be role based and proper log		

	report should be maintained by the system for such access.		
l.	Components of the architecture must provide redundancy and ensure that there are no single points of failure in the key project components. Considering the high sensitivity of the system, design shall be in such a way as to be resilient to technological sabotage. To take care of remote failure, the systems need to be configured to mask and recover with minimum outage.		
m.	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. Using Firewalls and Intrusion detection systems such attacks and theft shall be controlled and well supported (and implemented) with the security policy. The virus and worms attacks shall be well defended with Gateway level Anti-virus system, along with workstation level Anti-virus mechanism. There shall also be an endeavour to make use of the SSL/VPN technologies to have secured communication between Applications and its end users. Furthermore, all the system logs shall be properly stored & archived for future analysis and forensics whenever desired.		
n.	The evidence of Infraction should be encrypted and protected so that any tampering can be detected.		
o.	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.		
p.	System shall use open standards and protocols to the extent possible and declare the proprietary software wherever used.		
q.	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.		

r.	The data provided for authentication of violations should be in an easy to use format as per the requirements of user.		
s.	User should be provided with means of listing the invalid violations along with the reason(s) of invalidation without deleting the record(s).		
t.	Basic image manipulation tools (zoom etc.) should be provided for the displayed image but the actual recorded image should never change.		
u.	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).		
v.	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, Regn. Number of violating vehicle and actual violation of violating vehicle etc. so that the complete lane wise junction behaviour is recorded including (Red Light violation and Stop Line Violation)		
w.	Number plate should be readable automatically by the software/interface. There should be user interface for simultaneous manual authentication / correction and saving as well.		
x.	Interface for taking prints of the violations (including image and above details).		

3.5.2 E Challan System application

#	Minimum Requirements	Bidder Compliance(Yes/No)	Product Documentation Reference
A.	Make	<to be provided by the bidder>	
B.	Model	<to be provided by the bidder>	
C.	General		
1.	E-challan software shall work in client -server mode, where 50 handheld devices units will act as clients connected to the server through cellular network for data transfer. The system should be scalable to 500 devices, which may be added later on, server requirements to be		

	calculated as per scalability for 500 devices, which may be added later on.		
2.	E-challan system shall be able to retrieve vehicle owners details and vehicle data from RTO data base to minimise data entry		
3.	Server should maintain log of all current devices. Any access to the system must be recorded along with date, time, user id and IP address		
4.	Traffic officer should log in to the hand held device through the unique user id and pass word or smart card issued for the purpose		
5.	A unique challan number should be generated through client software for each challan		
6.	As soon as a vehicle registration number is entered , the handheld device should automatically check from the server if the vehicle is stolen , wanted in any criminal case or is in the list of suspicious vehicle		
7.	The most frequent traffic offences should be kept at the top in the drop down menu and offence ingredients should be available if required by officer		
8.	Date, time and GPS coordinates of place of challan should be automatically populated in the relevant fields of client software		
9.	Compounding amount must populate in the field automatically from master table		
10.	The successful bidder should develop the GUI and functionality as per requirements of the Police		
11.	The GUI should be lingual i.e English and local state language		

12.	It should be possible to integrate payment gate way operator with the system for felicitation of payment		
D.	Handheld Device Software		
13.	Once the application is loaded on the hand-held device there should be no possibilities to modify the application by the user. Reloading and modifying of application should be possible only by an administrator.		
14.	On switching on the hand-held device the system must give access only after validation through user ID and password.		
15.	The communication between the server and hand-held device would be through GSM/GPRS/ 3G/4G or better connectivity etc.		
16.	Every challan created must have a unique self-populated number.		
17.	The Handheld application must be able to access information from the main Server and display upon request, pop- up tables/codes, vehicle and license details, all types of offences, compounding amount, challan types, vehicle details, court calendar etc. in order to minimize the typing by the prosecuting officer.		
18.	The Handheld device should be able to access data/ information on the basis of driving license number, vehicle registration number etc. from the main server data relating to previous offences.		
19.	The hand-held application software should also suggest date of challan, place of challan, name of the Court and court date etc. to further reduce typing by the officer. These fields should be designed in consultation with Police.		

20.	When a challan is issued, the name and ID of the officer should be printed on the challan.		
21.	The Handheld device must be able to input and print multiple offences on the same challan.		
22.	The Handheld software must validate challan fields automatically before the challan is printed. The system must ensure that certain fields are properly completed before allowing the challan to be printed.		
23.	When downloading application software or pop-up tables or lists to the Handheld, or uploading challan records to the Server, synchronization of Handheld system must be automatic, in order to minimize human intervention.		
24.	Uploading data to the Database Server should be automatic in consistent manner.		
25.	The application should provide features wherein when a driving license/ vehicle registration number is entered; it should be able to pull from the server all the details relating to the driving license holder/ vehicle owner including history of previous offences.		
26.	Software should capture the list of documents seized during prosecution and such list must be reflected on the printed court challan.		
27.	The handheld application software shall allow the user to generate a summary report to facilitate evaluation of his daily work.		
28.	Once the challan is complete and saved any further editing should not be possible unless so authorized by administrator.		
29.	Each hand-held device should be provided with original printed user manual and		

	appropriate carry case for Handheld device with charger.		
30.	The application software should allow online payment		
31.	There should be automatic rejection of payment for the settlement of expired notices or challans. Partial payment of an offence must not be accepted by the system.		
32.	The software should update DL/RC smart card with the booked offence.		
E.	E-Challan Application Software		
33.	The Application Software should work in a web based environment.		
34.	The application software should be user friendly, easy to operate even by police personnel with minimum qualification of that of a head constable.		
35.	The software must provide comprehensive data back-up and restoration capability.		
36.	The system will function in web-based system where the hand-held device shall work as a node.		
37.	The application software should maintain the logs of user activities to facilitate the audit trail.		
38.	The system should have sufficient security features such as biometrics, password protection, audit trail, etc.		
39.	The system should be able to handle the activities of all the handheld devices at one time simultaneously with huge database size of prosecution, ownerships, driving license etc. without affecting the performance.		

40.	The software should be able to generate various periodical reports, summaries, MIS reports, query reply etc. as per the requirements of Police.		
41.	Administrator should be able to modify the master tables as and when required and should have the capability to push the changes to hand-held devices.		
42.	Software up-gradation must be provided by the MSI from time to time as per available technology without further cost impact to Warangal Police.		
43.	The Department will provide the entire data of vehicle ownership and driving license for integration with the vendor's application software.		
44.	All database tables, records etc. required for various dropdown menus etc. shall also be created by the MSI.		
45.	The application software is to be provided by the MSI to handle various processes of the prosecution required by the office of senior police officers, Courts etc.		
46.	The application software should have the capability to export records in CSV, SQL and binary format		

3.6 Traffic Enforcement System – Technical Specifications

3.6.1 Red Light Violation Detection

#	Parameter	Minimum Specifications or better	Bidder Compliance (Yes/No) (Yes/No)	Product Documentation Reference
1.	Make	<to be provided by the bidder>		
2.	Model	<to be provided by the bidder>		
3.	General			
	The system should be capable of generating a video & minimum 3 snapshot in any of the standard industry formats (MJPEG, JPG, avi, mp4, mov, etc) with at least 10 frames per second. The video shall be from t-5 to t+5 sec of the violation and should also be recorded (being the instant at which the infraction occurred).			
4.	Digital Network Camera			
a.	Video Compression	H.264		
b.	Video Resolution	1920 X 1080		
c.	Frame rate	Min. 30 fps		
d.	Image Sensor	1/3" Progressive Scan CCD / CMOS		
e.	Lens Type	Varifocal, C/CS Mount, IR Correction full HD lens		
f.	Lens#	Auto IRIS 5~50mm /8 – 40 mm, F1.4		
g.	Minimum Illumination	Colour: 0.5 lux, B/W: 0.1 lux (at 30 IRE)		
h.	IR Cut Filter	Automatically Removable IR-cut filter		
i.	Day/Night Mode	Colour, Mono, Auto		
j.	S/N Ratio	≥ 50 Db		
k.	Auto adjustment + Remote Control of Image settings	Colour, brightness, sharpness, contrast, white balance, exposure control, backlight compensation, Gain Control, True Wide Dynamic Range		
l.	Local storage	Minimum 64 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. 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.		
m.	Protocol	IPV4, IPV6, HTTP, HTTPS, FTP/SMTP, RTSP, RTP, TCP, UDP, RTCP, DHCP, UPnP, NTP, QoS, ONVIF Profile S		
n.	Security	Password Protection, IP Address filtering, User Access Log, HTTPS encryption		
o.	Operating conditions	0 to 50°C (temperature), 50 to 90% (humidity)		
p.	Casing	NEMA 4X / IP-66, IK10 rated		
q.	Intelligent Video	Motion Detection & Tampering alert		
r.	Alarm I/O	Minimum 2 Input & 1 Output contact for 3 rd part interface		
s.	Certification	UL/EN, CE,FCC		
5.	On site-out station processing unit communication & Electrical Interface (Junction Box)			
a.	Data Storage on site	The system should be equipped with appropriate storage capacity for 7 days 24X7 recording, with overwriting capability. The images should be stored in tamper proof format only.		
b.	Network Connectivity	Wired/GPRS based wireless technology with 3G upgradable to 4G capability.		
c.	Minimum 2(two) USB Port to support the latest external mass storage devices and Ethernet (10/100) Port for possible networking. However			

	all logs of data transfer through the ports shall be maintained by the system.		
d.	The system should be capable of working in ambient temperature range of 0°C to 60°C.		
e.	Lightening arrester shall be installed for safety of system (As per BIS standard IS 2309 of 1989).		
f.	The housing(s) should be capable of withstanding vandalism and harsh weather conditions and should meet IP66, IK10 standards (certified).		
6.	Violation Transmission and Security		
a.	Encrypted data, images and video pertaining to Violations at the Onsite processing station should be transmitted to the Interim ICCC/ICCC electronically through GPRS based wireless technology with 3G upgradable to 4G, or wired connectivity if available in Jpeg format		
b.	Advanced Encryption Standard (AES) shall be followed for data encryption on site and Interim ICCC/ICCC, and its access will protected by a password.		
c.	The vendor shall ensure that the data from the onsite processing unit shall be transferred to Interim ICCC/ICCC within one day.		
7.	Video Recording		
a.	The system should be capable of continuous video recording in base station for 7 days. The system shall automatically overwrite the data after 7 days. It should be noted that at any point of time the local storage at the base station should have the data of previous 7 days.		
b.	Direct extraction through any physical device like USB flash drive , Portable Hard disk etc. shall be possible		

3.6.2 E Challan Handheld device

Sr. No.	Parameter	Description	Bidder Compliance (Yes/No)	Product Documentation Reference
1	Make	<to be provided by the bidder>		
2	Model	<to be provided by the bidder>		
3	Core Board			
A	Operating System	Latest Windows, Linux or Android OS		
B	Processor	Min 800 MHz		
C	Memory (Flash ROM)	Minimum 512 MB		
D	RAM	256 MB Min		
E	Extend Slot	Micro SD 32 GB		
4	Motherboard			
A	Display	Minimum 3.5 inch TFT LCD (Trans reflective screen VGA/QVGA)		
B	Touch Screen	Yes		
C	Form Factor	Any		
D	GPS	GPS and A GPS		
E	Bluetooth	Yes		
F	Wifi	WiFi (802.11 b/g/n)		
G	Thermal Printer	Direct thermal line printing 3 inch		
H	Barcode scanner	1D and 2 Scanner		
I	External Interface	USB HOST/RS232(Customized)		

J	Protection class	IP54		
K	Drop resistance level	1.5m		
5	Camera			
A	Camera	3 MP Min		
B	Camera- Video	Support still image and video capture		
6	Keypad			
A	Front	QWERTY 42 Keys function key can be soft key		
7	Interface			
A	Mini-USB Connector	USB2.0 connection		
B	SIM card slot	Yes		
C	TF card slot	Yes		
D	power jack	Yes		
E	Audio Jack	Yes		
8	General			
A	Battery Type	rechargeable Li-ion battery 3000mAh		
B	Operating temperature	0°C--50°C		
C	Storage temperature	0°C -- 50°C		
D	Operating humidity	10%--80%		
E	Storage humidity	10%--90%		
F	Payment PINPAD	The device should have IPCI , EMV certified PINPAD as per RBI guideline for		

		accepting payment through Credit / Debit card		
G	Enclosure	Rugged		

****Removed VMD and ECB specs since RFP does not require and BoQ does not specify ****

3.6.3 L2+ 8 Ports Managed PoE Switch (Edge Level switch (For field Locations))

#	Parameter	Specifications	Bidder Compliance (Yes/No)	Product Documentation Reference
12.	Port Density & Redundancy	The switch should be rugged outdoor DIN rail mountable 8 ports 10/100/1000TX PoE+(min. 4 Port IEEE802.3at Or 8 Port 802.3af) and with 2 100/1000x SFP ports May require higher port density at some locations, depending upon site conditions		
13.	PoE Standard	IEEE 802.3af/ IEEE 802.3at or better on all ports simultaneously		
14.	Quality of Service	Support for Egress rate limiting, Eight egress queues per port, Voice VLAN, DSCP for IP-based QoS, Differentiated services architecture, IEEE 802.1p Class of Service with strict and weighted round Robin scheduling.		
15.	Multicast support	IGMP Snooping V1, V2, V3		
16.	Management	SNMP V1,V2,V3, Web GUI, CLI, USB or equivalent memory card, IP v6 management feature on open standards, IEEE802.1ag, TDM or equivalent standards		

17.	Security	Should support Access Control Lists (ACLs), DHCP snooping, IEEE802.1x based port authentication, RADIUS, TACACS, SSL, SSH, port mirroring, NTP		
18.	Resiliency	IEEE802.3ac, IEEE802.3az, IEEE802.1v, IEEE802.1q, IEEE802.1d, IEEE802.1s, IEEE802.1w, ring resilience/ring protection		
19.	PoE Power per port	Sufficient to operate the CCTV cameras/edge devices connected		
20.	Enclosure Rating	IP 30 or equivalent Industrial Grade Rating(to be housed in Junction box)		
21.	Operating Temperature	0 -60 C or better Industrial Grade Rating		
22.	Safety Certifications	UL/EN/IEC or equivalent, RoHS standards, NEMA –TS2		

Note: Bidder should note that the switches are compatible with the Telangana State Fiber network which is envisaged to be operational in due course of time.

3.7 Smart Parking Management System – Functional Requirement

3.7.1 Identifying vehicles at Entry/Exit

#	Description	Bidder Compliance (Yes/No)
1	The smart parking solution should be able to count the number of vehicles entering and exiting any parking structure	
2	The smart parking solution may use video camera based analytics or other sensor based solutions to determine number of vehicles entering and exiting parking lots. The smart parking solution should do so at each floor, in case of multilevel parking and communicate the data	
3	The smart parking solution must geo-reference all the parking lots.	

3.7.2 Visibility of vacant parking spaces and fare revision

#	Description	Bidder Compliance (Yes/No)
1	The total number of slots and free slots for parking must be displayed on a digital signboard near the entrance of the parking lots	
2	The smart parking solution should report occupancy of parking lots to a central software application deployed at the Integrated Command and Control Center.	
3	The smart parking solution should facilitate real time revision of parking fees and should enable real time communication of rules to handheld terminal, parking	
4	The smart parking solution should enable GWMC and Traffic Police to obtain real time situational awareness about the occupancy of parking lot through smart dashboard	
5	The smart parking solution should enable citizens to obtain real time space availability and slot reservation capability via mobile app or web client.	

3.7.3 Ticketing

#	Description	Bidder Compliance (Yes/No)
1	The smart parking solution should enable GWMC or any other appointed third party to facilitate generation of parking receipts and tickets based on occupancy of parking lots.	
2	The smart parking solution needs to have parking ticket vending machine at the entrance where the ticket can be issued by the machine on pressing the button by the user/ operator. Further, the solution will have provision for a handheld device through which parking receipts can be generated on payment of fees through card or cash	
3	The ticket, QR Code and Smart Parking Card or any other technology used by the SI should be capable of capturing data that is easily retrievable at the exit.	
4	Should include the provisions for the following types of parking reservations:	
4a	Walk-In Parking: This category of parking will include the citizens who drive in to the parking without any prior booking. The citizens can be provided with a QR coded ticket or any other advanced technology as deemed fit by the System Integrator	
4b	Online Reservation of Parking spots: The citizens should be able to reserve parking spots through online web application or the Citizen Mobile app. The pre-booking would be retained for a specific period of time and reassigned in case of no show. The motorists booking parking slots under this category can be identified with a QR code based or any other advanced technology as deemed fit by the System Integrator.	
4 c	Pass Based Parking: There should be an option for users to buy monthly, quarterly or yearly passes for hassle free experience. The motorists opting for this category would be identified using RFID based, NFC based smart card or any other advanced technology as deemed fit by the System Integrator.	
4d	Premium Paid Parking: There should be an option for users to choose premium parking spaces for e.g. near the entrance or exit. The corporate offices can also choose this option to reserve premium parking space for their employees. The motorists opting for this category would be identified using RFID based, NFC based	

	smart card or any other advanced technology as deemed fit by the System Integrator.	
4e	Smart Card based Parking: There should also be an option for users to be able to enter by flashing the smart card without any need to generate ticket.	

3.7.4 Payment

#	Description	Bidder Compliance (Yes/No)
1	The payment collection can be done via card as well as cash (manually) at the kiosk where parking ticket can be shown/ given to the staff at the exit. Parking staff should be able to scan the ticket and provide the printed receipt.	
2	The system must be tamperproof.	
3	Smart Cards shall be provided to regular users of the parking lots. The Smart Card must have the details of the user, the registered vehicle number (This may be a future requirement)	
4	Along with paper ticket, the SI can propose a cost effective smart parking solution to include NFC enabled prepaid Smart Card System for premium customers and customers opting for monthly reserved parking passes.	
5	The NFC enabled smart card reader would be available at pay station and would automatically deduct the requirement payment towards parking (This may be a future requirement)	

3.7.5 Parking Management System

#	Description	Bidder Compliance (Yes/No)
1.	The smart parking solution should retain videos of car entering /exiting the parking zone as per the security parameters defined in the tender.	
2.	The SI must ensure that all parking slots are individually and clearly marked. The smart parking solution should enable accounting and mapping of individual parking spots. All newly proposed parking spots must have one-to-one mapping with parking sensors. From existing ones, except for the very small ones, all rest will eventually have one-to-one mapping with parking sensor.	
3.	There should be a provision to increase or decrease the number of parking spaces that can be reserved online through web client or mobile App, and same must reflect on web clients or mobile apps	
4.	Parking Management System must geo-reference all the parking lots and shall have the ability to add more locations in future. Smart parking solution should enable accounting and mapping of individual parking spots to different operators/agencies and	

	monitor the parking space utilization and revenue from those facilities	
5.	Each off-street parking lot can have a local server for storage and hosting the local parking management application while on-street parking lot payment system can connect via City Wi-Fi or other Communication network to central server for exchange of data/information.	

3.7.6 Accessibility of real time Parking space availability over Web client and Mobile App

#	Description	Bidder Compliance (Yes/No)
1.	The smart parking solution should provide real time location based view to citizens about proximity of parking lots and availability of parking lots.	
2.	The smart parking solution should have a mobile and a web delivery channel for citizens to get real time parking availability and pre book parking lots using online payment of parking charges facilitated through a payment gateway	
3.	<p>A mobile application and web based user interface should be provided with the following features:</p> <ul style="list-style-type: none"> a) The application should have citizen module and officer module. b) The citizen should be able to see all the parking lots with exact available space in a real time mode. c) While locating nearest parking lot, the most updated parking slot availability should be given to the user. d) Through the citizen module, the user should be able to locate nearest parking lot and also pre-book based on his geographical coordinates. The same information must be made available on map with routing information. e) Citizens should be given an option to extend the pre-booked parking space f) Reservation should be permitted for specially-abled citizens too. g) A convenience fee will be charged for all online booking, and there will be some penalty levied in case of cancellation after the specified time period. h) The application should have a compliance officer module where GWMC designated inspector / operator will be able to check compliance of slot occupancy against the fees paid by the citizen. i) The citizens should be able to generate MIS report to view their occupancy of parking lots over a defined time period. j) The administrators should be able to generate MIS report to view occupancy, collection and other usage statistics over a defined time period. 	

3.7.7 Integration

#	Description	Bidder Compliance (Yes/No)
1.	Hardware: Integration information related to all smart parking components, including hardware components like Entry and Exit devices, barriers, handheld wireless devices, sensors, Smart Cards and software applications to perform parking related functions like payment, reporting, tracking, providing guidance etc. This information will be monitored and managed in the Emergency Operations Center	
2.	Smart Card: Integration with Smart Parking solution w.r.t identification of vehicle as well as recording time and deducting parking fees at the time of exit.	
3.	Integrated Command and Control Center: Integration with ICCC for continuous monitoring and be able to respond for any failure of hardware components or any emergency situation at Parking lot.	
4.	Mobile App or web client: Integration with Mobile App and web client to provide real time information on the availability of spaces in nearest or all parking lots.	

3.7.8 Accounting

#	Description	Bidder Compliance (Yes/No)
1.	Should provide an application with analytics capability for providing details such as Usage and Vacancy periods, premium parking demand etc.	
2.	The solution should be automated, reliable, cost effective, secure, scalable, environment friendly, energy efficient, and must entail minimum human intervention for day-to-day parking management.	
3.	System should be able to integrate with ITMS application, in order to identify restricted or not listed vehicles etc.	
4.	The smart parking solution should enable the above functions with minimum manual intervention	

3.8 Smart Parking Management System - Technical Specifications

3.8.1 Entry/Exit Barriers

#	Description	Bidder Compliance (Yes/No)
1.	Three phase 0,37 CV motor	
2.	Scaled, self-lubricating motor	
3.	Movement transmission is done by ball-bearing-supported connecting rods	
4.	Opening/ closing time: from 0,8 sec to 8 sec Depending on the mounted arm (standard: 1,2 secs. For an arm of 3m.)	
5.	Low maintenance rate: soft start and stop movements without arm oscillations	
6.	Emergency stop feature by a photocell or pressure strip (optional)	
7.	Optional UPS (Uninterrupted Power Supply) to continue operating when mains supply's fails (max. 100 up/ down movements)	
8.	Internal memory of 7 pulses with Automatic reset on down signal loose	
9.	Polyester powder painted and oven-dried steel housing	
10.	Operating temperature: -20 °C a +55 °C Single phase power supply: 220 Vac. ± 10% 50 Hz (110 Vac. ± 10% 60 Hz. optional) Operating consumption: 330 w. maximum The Barrier unit must conform to ISO 9001 Quality Assurance Standard CE, Ukr - Sepcro certified Degree of Protection: IP34D	

3.8.2 Handheld Ticketing Dispenser

#	Description	Bidder Compliance (Yes/No)
1.	The wireless handheld device should be able to dispense a ticket (with printed QR Code)	
2.	The same device should be able to scan the same QR code ticket while leaving and generate and print receipt after receiving payment	
3.	The handheld should have the capability to allow personnel to enter the Unique Booking Code of the motorist	
4.	The handheld should also have NFC capabilities to be able to read NFC enabled Smart Card, Monthly passes, etc.	
5.	The handheld should be IP based and Wi-Fi enabled and should be monitored from the Emergency Operations Center	
6.	The handheld device will have the basic parking metering and management application, which will be synced with the overall	

	Parking Management System, and its data will be communicated back and forth from the centralized Emergency Operations Center.	
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3.8.3 Automatic Ticketing Dispenser

#	Description	Bidder Compliance (Yes/No)
1.	Ticket dispenser with magnetic recording and printing of date, time and other data of car entrance to parking, side and central strip versions	
2.	Magnetic reader of season cards on the same reader mouth as ticket issuer device. Smart card reader (option)	
3.	Credit card access control system available as an option Proximity card (contactless smart-card) reader for season cards control (optional)	
4.	Automatic/ manual ticket issue activated by vehicle presence detector	
5.	Checking/ validation of season cards, full/ partial time, residents, restricted areas cards as well as master cards, monetary value, time limit and other system card as. Anti-pass back controls on cards	
6.	Control of vehicle passage sequence, sending ticket code as "cancelled" to the Central Unit in case of abnormal operation	
7.	Barrier alarm control and management and controls manual barrier opening	
8.	Electronic self-adjusting vehicle presence detector that prevents ticket extraction by pedestrians	
9.	User-oriented alphanumeric information display in two languages with TFT monitor in option	
10.	Date and time visualization on display while inactive	
11.	Ticket loading container with capacity for 5000 tickets with Ticket level control	
12.	Motorized magnetic ISO strip reader/ recorder	
13.	Ethernet communications connection to the central unit with Optional RS-422 connection	
14.	Pocket terminal connection for maintenance processes Autonomous operation	
15.	Electronically controlled internal heating/ ventilation system	
16.	Polyester powder painted and oven-dried steel housing	
17.	Operating temperature: -20 °C a +55 °C Protected environment use (roofed) Power supply: 220 Vac. ± 10% 50 Hz (110 Vac. ± 10% 60 Hz. optional) Maximum consumption 70 w (270w with heater option) Conform ISO 9001 Quality Assurance Standard CE, FCC, IC, CNRTLUS certified	

3.8.4 Parking Sensors (future requirement)

#	Description	Bidder Compliance (Yes/No)
1.	Sensors should be used for detecting the real-time status of the parking space	
2.	It should be able to upgrade its firmware/functionality remotely from the Central Control Center Or Integrated Command control center	
3.	It should be able to permit an optimal angle between the sensor output and target	
4.	Sensor should be able to work in all weather conditions relevant to the project site	
5.	Sensors should preferably have magnetic or optic technology	
6.	Conform ISO 9001 Quality Assurance Standard Protection Level: IP67	

3.8.5 Ticket Validator

#	Description	Bidder Compliance (Yes/No)
1.	Motorized magnetic strip reader/ recorder ISO standard, side and central strip versions	
2.	Control/ validation of exit tickets and different types of season cards	
3.	Allow up to 4 periods of grace to be chosen for different exits	
4.	Inner container to collect exit tickets	
5.	Control/ validation of season cards, full/ partial time, residents, restricted areas cards, QR code or BAR code recognition from mobile devices as well as monetary value, time limit and others system cards	
6.	Anti-pass back control on cards	
7.	Control of vehicle passage sequence, sending to the Central Unit the ticket/ card code as to include it in the black list	
8.	Barrier alarm control and management. Controls manual barrier opening <ul style="list-style-type: none"> 1. Self-adjusting electronic vehicle presence detector. Impedes ticket or card validation by pedestrians 2. User-oriented alphanumeric information display in two languages. TFT monitor in option 3. Date and time visualization on display while inactive 4. Ethernet communications connection to the central unit. Optional RS-422 connection 5. Pocket terminal connection for maintenance processes 6. Autonomous operation 7. Electronically controlled internal heating/ ventilation system 8. Polyester powder painted and oven-dried steel housing 	

	<p>9. Operating temperature: -20 °C a +55 °C</p> <p>10. Protected environment use (roofed)</p> <p>11. Power supply: 220 Vac. ± 10% 50 Hz (110 Vac. ± 10% 60 Hz. optional) Maximum consumption 70 w (270w with heater option)</p>	
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3.8.6 Parking Management and Guidance System

#	Description	Bidder Compliance (Yes/No)
1.	The solution will be implemented in the Integrated Industry Standard Open Platform to manage, monitor and control Smart Parking initiative. Integrated Industry Standard Open Platform should have API based access to the Parking Management and Guidance System as well as the devices utilized for parking.	
2.	The solution should be able to monitor and configure all devices with respect to parking (sensors, displays, and signal converters).	
3.	It should control the system functionality and monitoring should be done from other computers and remotely.	
4.	It should provide capability to create full report of exact location with respect to floors, areas, levels, etc. It should be customizable and update about occupation and movements of vehicles in real time.	
5.	It should provide real time monitoring of all system status.	
6.	It should report alarms when devices are not connected or when any equipment failure occurs.	
7.	The software should notify alarms after a period of time if a car is abandoned.	
8.	The software should provide full graphical plan information of the car park with exact locations.	
9.	The software should allow downloading the information and configuration of fields for maintenance purpose	
10.	The software application should have built in tools for third party integration to obtain real time information	
11.	Should provide access at user levels with passwords	
12.	The software should have historic log for available spaces, period of time.	
13.	The software should be able to handle manual overriding of available spaces, special parking requirements for reserved spaces and handicapped lots	

3.8.7 Payment Kiosk

#	Description	Bidder Compliance (Yes/No)
1.	Accept different types of coins and returns changes	

2.	Programmable automatic recharge of out-of-stock coins by means of a safe container with an approximate 500 coins capacity	
3.	Banknote acceptor for different notes types in any of the 4 insertion directions with two deposits for recycling, storage and change returns (optional) and a capacity of 120 banknotes for cassette	
4.	Safety banknote collection box (optional)	
5.	Thermal printer (no printer ribbon required) for receipts, payment vouchers, liquidation and accounts states	
6.	Automatically issues liquidation voucher on withdrawal of safety boxes (coins or notes). The voucher specifies the content of box number of coins/ notes of each type and total	
7.	Accepts payment with discount, money and time vouchers	
8.	Accepts credit card payment	
9.	Payment allowed for expended extra time by part-time season holders	
10.	Multilingual information display with 12" TFT monitor	
11.	Motorized magnetic ISO lateral strip reader/ recorder	
12.	Optional magnetic card reader/collector	
13.	Ethernet communications connection to the central unit. Optional RS-422 connection	
14.	Pocket terminal connection for maintenance processes	
15.	Powerless Operation: Incorporating a UPS to enable the credit pay station to complete operations in progress in the event of a power supply failure	
16.	Polyester powder painted and oven-dried steel housing	
17.	Operating temperature: -5 °C a +50 °C	
18.	Protected environment use (roofed)	
19.	Power supply: 220 Vac. ± 10% 50 Hz (110 Vac. ± 10% 60 Hz. option)	
20.	Maximum consumption: 200 w. (400 w. with heater option)	

3.8.8 Variable Messaging Board

#	Description	Bidder Compliance (Yes/No)
1.	Source of light: High intensity LEDs	
2.	Color: True Color	
3.	Brightness: >8000 cd/m ²	
4.	Luminance Class: L-3 as per EN 12966	
5.	Contrast Ratio: R2-R3 as per EN 12966 Beam Ratio: B-3 as per should be wide angle B6 or B7 or B4 Viewing distance: >300 meters	
6.	Display capability: Alpha-numeric, Pictorials, Graphical & Video	
7.	Display Front Panel: 100% anti-glare	

8.	Language: Multilingual (Telugu /English) and all fonts supported by windows.	
9.	Auto Dimming: Auto dimming adjust to ambient light level.	
10.	In built sensor: Photoelectric sensor	
11.	Storage capacity: Minimum 100 GB	
12.	Display area: Display size of VMD should be 3x2 m	
13.	Number of Lines &Characters: The number of lines and characters can be customized as per the requirements (Min. 3 lines & 10 characters)	
14.	Brightness & control: Controlled through software	
15.	Display Driving method: Direct current control driving circuit. Driver card of display applies Direct Current Technology.	
16.	Display Style: Stay on and flashing	
17.	Connectivity: IP based	
18.	Access control: Access control mechanism would be also required to establish so that the usage is regulated.	
19.	Integration: With smart city operations center and service providers for offering G2C and B2c services.	
20.	Construction: Cast Iron Foundation and M.S. Pole, Sturdy Body for equipment.	
21.	Battery: Internal Battery with different charging options (Solar/Mains)	
22.	Power: Automatic on/off operation	
23.	Casing: IP-55 rated for housing	
24.	Operating conditions: 0 Degree to 55 degree C	

3.8.9 Emergency Call Box

#	Description	Bidder Compliance (Yes/No)
1.	IP rating: IP66	
2.	Front panel: Stainless steel cover	
3.	Internal speaker amplifier: 10W class D	
4.	Microphone technology: Digital (MEMS)	
5.	Echo cancellation	
6.	Noise cancelling (static)	
7.	Web browser configuration	
8.	Software configuration	
9.	General Purpose I/O: 6 (configurable)	
10.	Power Option: PoE or external supply	
11.	Operating temperature: -25°C to 70°C (-13°F to 158°F)	
12.	Relative humidity: 0% - 95% Weight 800g (1.73 lb.)	
13.	Dimensions: 180 x 120 x 70 mm (7.1 in. x 4.7 in. x 2.75 in)	

3.8.10 Wireless Gateway

#	Description	Bidder Compliance (Yes/No)
1.	Wireless Gateway shall communicate with northbound network through dedicated leased lines connecting central control center or through pre-terminated MPLS circuits over fiber network	
2.	Wireless Gateway shall communicate wirelessly at 2.4Ghz/5 Ghz ISM band with 128 bit AES encryption with southbound devices like wireless Repeaters and parking sensors	
3.	Every Repeater shall have battery backup for 6 hours of operation and powered through AC mains	
4.	Wireless Gateway shall have IP67 protection	
5.	Wireless Gateway shall connect upto minimum 10 repeaters within its radio range	

3.8.11 CCTV Cameras

#	Description	Bidder Compliance (Yes/No)
1.	Video Compression: H.264	
2.	Video Resolution: 1920 X 1080	
3.	Frame rate Min.: 25 fps	
4.	Image Sensor: 1/3" OR 1/4" Progressive Scan CCD / CMOS	
5.	Lens Fixed: 3.6mm or better	
6.	Minimum Illumination Colour: 0.5 lux, B/W: 0 lux with IR On	
7.	IR Range: 20 Mtrs or better	
8.	Day/Night Mode: Colour, Mono, Auto	
9.	S/N Ratio: ≥ 50Db	
10.	Auto adjustment + Remote Control of Image settings: Colour, brightness, sharpness, contrast, white balance, exposure control, backlight compensation, Gain Control, Wide Dynamic Range	
11.	Protocol: HTTP, HTTPS, FTP, RTSP, RTP, TCP, UDP, RTCP, DHCP, UPnP, QoS, IPV4, IPV6, ONVIF Profile S	
12.	Security: Password Protection, IP Address filtering, User Access Log, HTTPS encryption	
13.	Operating conditions: 0 to 50°C (temperature), 50-90% humidity	
14.	Casing: NEMA 4X / IP-66 rated and IK10 rated	
15.	Certification: UL/EN,CE,FCC	
16.	Local storage: Micro SDXC up to 64GB (Class 10) 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.	
17.	Power Source: PoE, 12V	
18.	Integration with ICCV is required	

3.8.12 Smart Card Reader (future requirement)

#	Description	Bidder Compliance (Yes/No)
1.	Display: 7" inches or higher scratch resistant multi point capacitive touch screen with minimum WSVGA resolution (1024 X 600). 3.5" QVGA with backlight, TFT-LCD, 260K, 240 x 320	
2.	Dimensions (W X H X D): 87 (min.74) x 218 x 56.2 (min.29)mm	
3.	Weight: 497 g to 502 g	
4.	CPU/Processor: 520MHz	
5.	RAM: 128MB RAM	
6.	Memory: 128MB ROM (Optional)	
7.	Expansion slot: At least a micro SD slot supporting up to 16 GB memory card	
8.	Audio: Good quality Speaker with 1W or higher output for announcements. Speaker, Headset jack	
9.	External Keyboard support: Device should support keyboard through USB or Bluetooth interface	
10.	Connectivity: Device should support both 3G, GPRS and Wi-Fi, should support GPS feature	
11.	USB Port: At least one free USB port shall be available after setting up the entire solution including peripheral devices	
12.	Battery: Rechargeable, 3.7V, 4,000mAh, Li-ion. Battery should be minimum 3000 MaH for the hand held terminal (HHT).	
13.	Operating system: Should support latest versions of iOS, Android and windows	
14.	Certification: RoHS (Restriction of Hazardous substance)CE or UL	
15.	Indicators: Status indicator provides ease of use, Indicators for connectivity (presence/absence), signal strength, battery status etc.,	
16.	Camera: 2 megapixel camera w/ LED Flash.	
17.	Barcode Reader: Barcode reader capable of reading 1D Laser Class II or 1D&2D CMOS Imager	
18.	SIM/ SAM Slots: Minimum 1 SIM and 2 SAM Slots (Security encryption of MI Card) to support secure loading of signed applications	
19.	Biometric Sensor: STQC certified Finger Print Module IRIS Scanner (Optional): STQC certified IRIS scanner Module	
20.	Smart Card Reader: ISO 7816 Compliant	
21.	Printer: Integrated or external. 2" thermal Printer (max. 90mm/sec)	
22.	Antenna (mandatory): Internal	
23.	Terminal Management: Device should be remotely manageable in secured mode	
24.	Warranty: Suitable Warranty support	
25.	Certification: PCI / EMV Certification (Bank Certified)	

	RFID Reader: Optional, ISO 14443 A/B (MIFARE, Calypso), ISO 15693; ISO 14443 A/B (MIFARE, Calypso), ISO 18092 (NFC), Felica Radio	
26.	WWAN Radio- Optional, CDMA 1x for Korea SKT, LGT; GSM/GPRS/eGPRS for global	
27.	WLAN Radio- IEEE 802.11b/g	
28.	WPAN Radio- Bluetooth V2.0+EDR Class II	
29.	Capabilities for Transaction and Payment	
30.	MSR- Bi-directional, Track1,2,3, ISO 7810, ISO 7811, ISO 7813	
31.	Contact Payment- EMV Level 1&2, ISO 7816	
32.	Contactless Payment- Optional, EMV Contactless Level 1 & 2 (Master PayPass, Visa Wave)	
33.	PIN Transaction- Optional, PCI PED 2.0; APACS Common Criteria; GIE CB Approved	
34.	GPS: Optional, Integrated GPS w/ AGPS and DGPS Environment & Durability	
35.	Operating -20°C to 55°C / -4°F to 131°F	
36.	Storage- -30°C to 70°C / -22°F to 158°F	
37.	Humidity- 93% non-condensing Damp heat Cyclic --Operating-40°C, 95%RH for (12+12 hrs.), No. of cycles: 2	
38.	Drop/Free Fall Specification- 4ft. / 1.2m drop to steel surface with silicon case, 2drops per 6 sides	
39.	Vibration Test should be in packed condition, switched off conditions (10-150Hz, 0.15mm/2g, 10 sweep, cycles/axes)	
40.	Bump test should be in packed condition, switched off condition.(1000Bumps, 40g, in vertical position)	

3.8.13 Loop Detector

#	Description	Bidder Compliance (Yes/No)
1.	Power supply: 200 - 260VAC 50Hz 1.5VA	
2.	NMI/MI Input: This input may be activated by a potential free relay contact or open collector NPN transistor output. This input is isolated from the logic.	
3.	Beam Input: This input may be activated by a potential free relay contact or open collector NPN transistor output. This input is isolated from the logic and is used to keep the barrier open when a vehicle has broken the beam.	
4.	Raise/Lower Output Relay: These outputs are a relay contact rated at 5A/220VAC.	
5.	TVI Output Relay: This output is a normally closed relay output rated at 0.5A/35VDC.	
6.	Indicators: LED indicators show: Power, Barrier Raised and Loop Detector.	
7.	Detector tuning range: 15 - 1500uH	

8.	Loop Frequency: Approx. 23 – 130KHz	
9.	Environmental tracking: Automatic Compensation	
10.	Protection: Loop isolation transformer with zener diodes and gas discharge tube.	
11.	Connector: 11 Pin Connector on rear of unit.	
12.	Dimensions: 80mm (height) X 40mm (width) X 79mm (Depth excl. connector).	
13.	Operating Temperature: -40°C to +80°C	
14.	Storage Temperature: -40°C to +85°C	

3.9 Intelligent Transit System – Functional Requirements

3.9.1 Indicative Scope of Work

The project will consist of design, development, testing, installation, commissioning, training, handholding operations, and management of facilities. This project shall be designed in a manner scalable to larger fleet size, depots and terminals including bus queue shelters.

The City Bus Intelligent Transport System shall bring a state of the art system for enhancement and monitoring of operational efficiency and automation to its transit and other allied operations. The system is expected to meet the Authority's objective of enhancing service standards, better planning and efficient operations; bring in commuter centric services, integration of para-transit, and automation of collection and payment of transit fares, revenue generation services like advertisement system.

The system will deliver the stakeholder requirements by integrating various solutions and technologies onto an integrated platform which will comprise of following distinctive application areas:

S. No.	System	Sub-System
1.	Vehicle Tracking System	A. Vehicle Location System(GPRS/GSM Communication)
		B. Passenger Information System (In-Bus and Announcement System)
		C. GIS information System
2.	Operation & Management System	A. Schedule Management System with crew allocation, trip planning and allied services
		B. Business Analytics Module
		C. Infrastructure Management System
		D. Fleet Diagnostic communication and management System (Vehicle Health Monitoring)
		E. Public Infotainment System
3.	Communication System	A. EPABX integration System
		B. Crew Communication System (2-Way)
		C. Advertisement and Public Announcement System
4.	Control Center at RTC Hanamkonda Depot	A. Integrated Command Centre Management with duty allocation and allied services
		B. Web based GIS map editing and GIS Map server management system <ol style="list-style-type: none"> 1. Route creation 2. Survey of bus stops/point of interest

		<ul style="list-style-type: none"> 3. Geo-Fencing 4. Fare Management/Rate Chart 5. Incident Management System <ul style="list-style-type: none"> a. Accident b. Breakdown 6. Grievance redressal 7. Pass/Concession Management System <p>C. Remote content management system</p>
		D. Display management system
		E. E-mail server, voice and SMS application and management system
5.	Automatic fare Collection System	A. Electronic Ticketing System with Handheld Ticketing Machine scalable to Smart Card reading
6.	Business Intelligence Platform for Reporting	A. Management dashboard
		B. Searching & Filtering
		C. Reporting
		D. Data Retrieval and Management
		E. ETL
		F. Data Quality Management
		G. BI Configuration and Management
		H. Dashboard and Reporting Requirement for ITMS
		I. Dashboard and Reporting Requirement for AFCS

3.9.2 Architecture of the system

The architecture defines the overall inter connectivity of different sub systems including inside vehicle, communication within sub system and connectivity to backend solutions for the transmission of the real time vehicle information. The functional aspect of the systems and sub-systems are described as under:

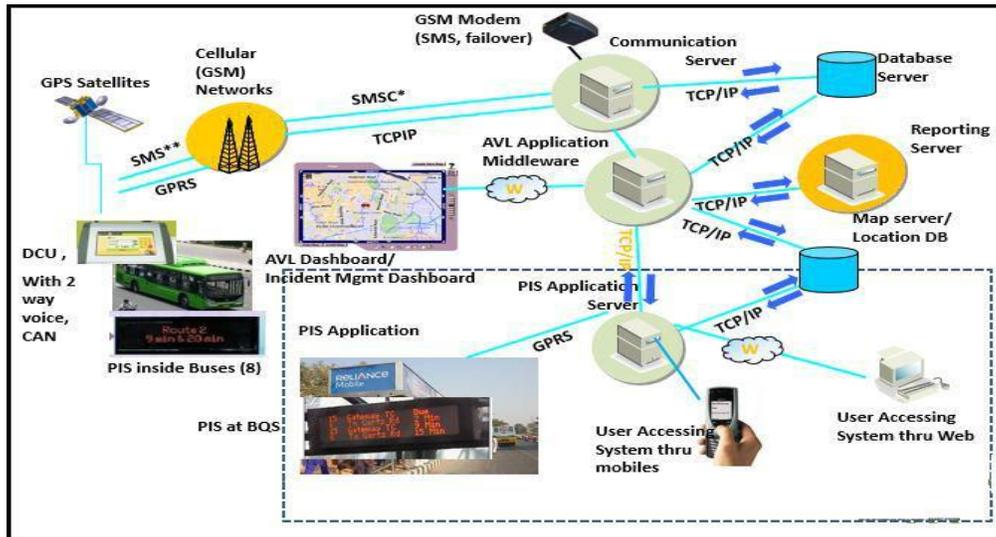
1. Vehicle Tracking System

The Track & Trace Communication system will track & trace the location of vehicle running. The GPS based Automatic Vehicle Location System will be used for tracking and tracing the vehicle. The following systems are used for Track & Trace system:

a. Vehicle Location System & Passenger Information System

The Vehicle Location System gives an agency the ability to track, record, and analyze how vehicles are performing in real time. These features lead to improvements in public transit service through better on-time performance and quicker response time to emergencies. The Location information along with

other details such as the speed of the bus, the route followed etc. is used to provide the passengers waiting at the bus stops with the Expected Time of Arrival (ETA) of the bus. The information are displayed on LED Display boards installed at the bus stops as well as inside the buses using the Public Information System boards , announcement systems, websites, mobile apps etc. The system also helps in improving the efficiency of bus operation by generating various standard and exception reports.



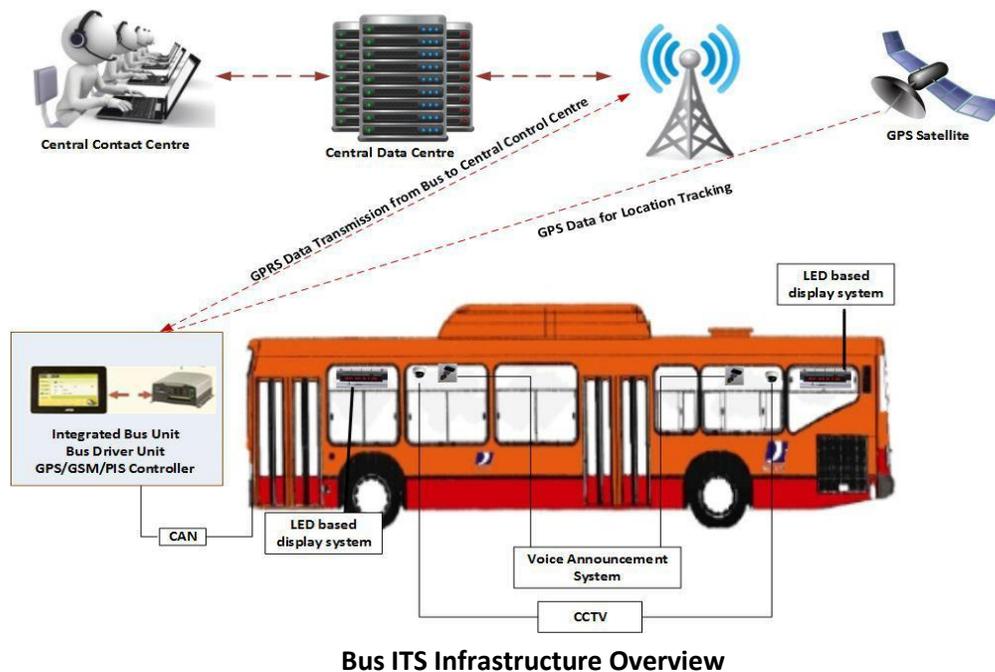
Conceptual Schematic of GPS based Vehicle Location System & Public Information System (PIS)

As shown in the figure above the Vehicle Location system consists of Vehicle Tracking Unit mounted on the buses which is used to send location as well as speed data to the central system for tracking the buses. The detail specification of bus mounted units shall be as per Urban Bus Specification II of MoUD, GoI. The Vehicle Tracking Control Unit provides the Location data to the Communication server as part of the Central Control Centre infrastructure which processes the information and saves the data in Database server to be stored and processed for other facilities by Vehicle.

Location System application which displays this information on GIS maps and also provides the location, speed and route data to the Estimated Time for Arrival (ETA) application to generated ETA for various bus stops. The Vehicle Location system will facilitate the Passenger Information System (PIS) to disseminated this ETA information to commuters in various modes like display screens, voice based information on buses and stop/station, web portal, mobile information delivery system, SMS based enquiry system.

b. On-Board System – Integrated Control Unit

The GPS/GPRS based integrated control unit (ICU) will control the in bus display boards as well as the announcement system. A bus may have up to four display boards mounted inside to display the upcoming Bus Stop & other relevant information. The ITS system planned for bus operations include following:



Bus ITS Infrastructure Overview

c. ITS at Bus Stop/Station/BQS/Depot /Terminals

As passengers arrive at the bus station/Stop/Depot/BQS, they need information at different stages before their departure. With bus station PIS system, passengers can easily view bus arrivals and departures as well as schedule changes, service advisories, etc. Supply of such GPRS/SMS based PIS system will be in scope of work of the bidder. PIS system will be as below:

- PIS Display on Bus Stations
- PIS at bus stations will be connected through mobile communication to Central Control Centre GIS module to generate the ETA information for various bus stops.
- PIS at Bus Station should be connected to ITS Data Centre.
- PIS algorithm to be used for ETA/ETD prediction, considering historical data, GPS data, Traffic data and others operating parameters
- Web Portal for Bus Schedule & ETA/Mobile Application

The vendor will develop integrated PIS system for web portal, Android and IOS and other leading mobile OS. The portal will be integrated with Smart City Portal which will be developed as part of future requirement. This Application will have provision for advertisement. To develop Content Management System with ability to remote management of Playlist, Sequence change, Location based ads, prioritization of ads, and dynamic change of Screen layouts.

2. PIS at Depot cum Terminal and Bus Queue Shelter (BQS)

- a. LED based Passenger Information Displays (Stations will have 2 number of LED based display terminals).
- b. The PIS information will also be made available via website, SMS and mobile apps.

- c. These applications will enable commuters to be able to plan their journey well in advance and will also ensure less waiting time at the stations). Each BQS will have two number of LED based display terminals.
- d. The vendor shall be responsible for Supply, Installation and Insurance of PIS. All spares required for the smooth operation of the ITS system shall be maintained by the vendor for the entire duration of the contract. Power for PIS displays will be facilitated and provided by the department.

3. Centralized control centre

One Central Control System will generate the necessary management reports received from the GPS based Vehicle Tracking system and PIS with provision for interoperability with smart cards for future. The Central control center will monitor the movement of vehicles to ensure their adherence to speed limits, routes and punctuality. Central control center will overall monitor and support entire operation like user creation, online support, Incident management (Accident and Breakdown); Depot control center /other control center management and Data center operation etc.

The vendor shall develop application module with Dashboard for each of the modules and role based access for the smooth operation of Central control center, and shall deploy support and maintenance manpower at the central/depot control center.

4. Operations Management System

The operations management system for the city bus will consists of the following system modules in integrated mode with the all other application system module. Basic functional requirement are as follows:

Scheduling Management System (also called as FLEET MANAGEMENT SYSTEM)

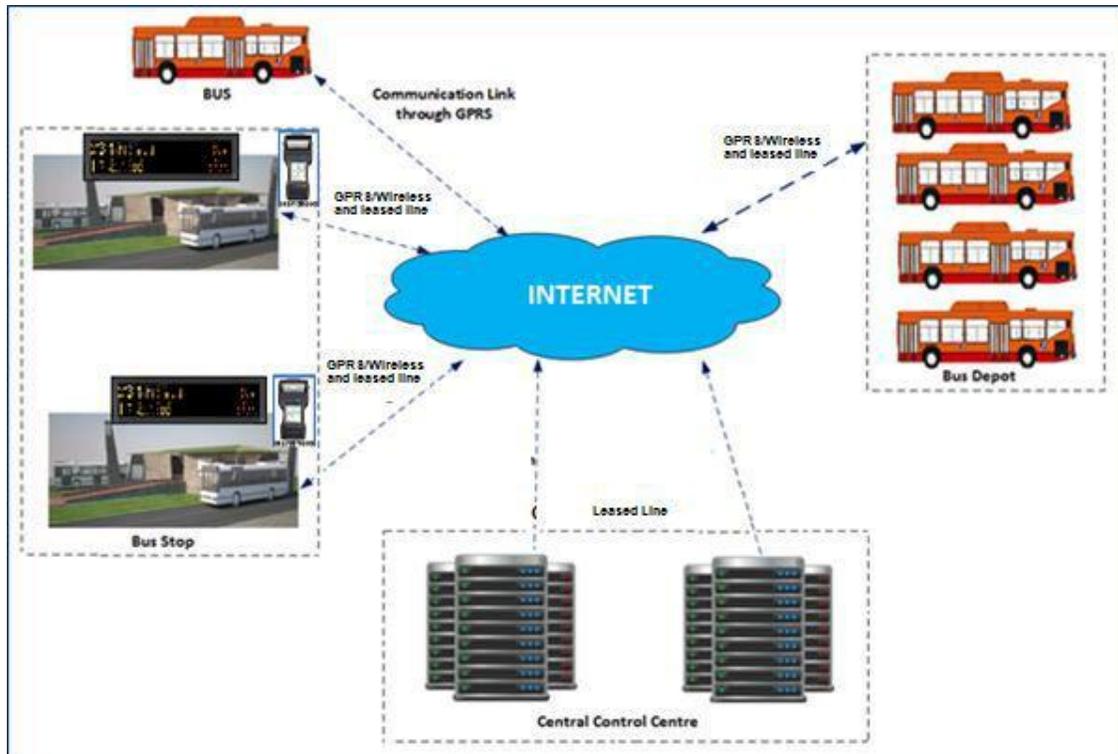
The Schedule Management System will provide city bus operator the ability to react quickly to operational problems such as:

- Provide daily Fleet Service Schedule, Maintenance Schedule, pending Insurance and pending Pollution Check status, Fuel Management,
- Vehicle job cards are prepared based on complaints and scheduled service
- Define schedule of duties in various routes.
- Creation of Conductors Way bill and Drivers Duty Roster.
- Allows sending a vehicle in exchange of break down/detained vehicles.
- Records fuel taken in by each vehicle and provides average fuel consumed per kilometer (EPKM = Earnings Per Kilometre & CPKM = Cost Per Kilometre). Automatic updation of changed Time Table in the Duty Roaster.
- Record each vehicle's scheduled and actual out time from bus stand and depot and scheduled and actual entry time in depot using RFID as well as without RFID.
- Crew allocation

Application will accomplish a series of specific tasks in the management of any or all aspects relating to a fleet of vehicles. Software, depending on its capabilities, allows functions such as driver and vehicle profiling, trip profiling, vehicle efficiency, etc.

5. Communication Overview

The figure below shows a pictorial representation of the communication network plan for city bus system. The communication system design is a very important part of the overall system design as the appropriateness of such design will influence the sustainability and operability of the system as a whole. The communication network depicted above takes in account the operations requirement as far as bus, bus station, depots, terminal's, data centre, control centre and data recovery site is concerned.



a. General Packet Radio Service (GPRS)

GPRS is required to be used for services such as Wireless Application Protocol (WAP) access, Short Message Service (SMS), Multimedia Messaging Service (MMS), and for Internet communication services such as email and World Wide Web access.

The information captured by the Integrated Control unit is to be transmitted to the control station server through GPRS/GSM network creating a communication network between Bus, Bus stops along the road, route, and passengers through passenger information system. The communication network is connected to the internet for accessing information regarding bus arrival, routes etc.

b. Overall basic system functional & operational requirement

The bidder will study the complete system including infrastructure, Buses, communications network availability etc. before bidding. The bidder through the study shall get a proper understanding of all aspect of project requirement-which might or might not be detailed in this document or may be added/amended/modified in SRS.

c. Track & Trace Communication System

The Track & Trace system will track & trace the location of vehicle running. The GPS based Vehicle Location System will be used for tracking and tracing the vehicle. The following systems are used for Track & Trace system. Vendor may use [the Authority] existing GIS base-map provided by client or approved by the authority for this project.

d. GPS BASED AVLS & PIS

A	General Requirement
1.	<p>GPS based Vehicle Location System will provide the following features:</p> <ul style="list-style-type: none"> a. Ability to locate a bus at a given time in its track to estimate its arrival/departure time at the next destination, based on traffic density, distance, speed, bus occupancy, run-time information from the previous bus arrival time for the same location etc.; b. Ability to send and receive SOS and alerts from moving / stranded buses enroute c. Facility to track defined vs. actual movement of vehicles, capture deviations if any. d. Facility to view vehicle movements real-time on digital maps e. Ability to provide dynamic location specific information as the vehicle approaches bus stop/station for the benefit of passengers f. Facility to generate information such as travel time estimation (to be captured in PIS), average time at bus stop, passenger traffic at different location, alerts on exceptions, and logging of the journey details of the bus for each trip g. Facility for citizens to access and view position / location information on GIS maps near real time through web interface with historic data displayed on maps h. Facility for providing current information location on demand i. Provide 2-way voice communication between the driver of the vehicle and the control CCC for receiving SOS and alerts from vehicle j. Facility for playing back the recorded details of the bus movement along the authorized route k. It should enable operational managers to create locations, routes, schedules Vehicle service alerts for service and maintenance l. Vehicle fleet summary dashboard – quick view on vehicle fleet performance m. Register a bus on unscheduled route from backend on real time basis n. Exception recording/ actions (over-speeding, off-route detection, non- stoppage at bus stops, trip cancellation) o. Display of real-time dynamic movement of buses plying on a selected route on map, with real time ETA displayed on stop points plotted on map

2.	The geographical position i.e. Longitude / Latitude coordinates, of each bus stop, Depot and bus station will be identified through a survey by the ITS vendor along with details of tourist centres / points of interest / places of attraction / monuments etc. along the route, precise distances between the bus stops in each route by the ITS vendor
3.	AVL system will provide these data on real time basis at pre-determined and configurable intervals over GPRS/wireless networks and shall support both the time mode (periodic updated based on time interval and distance mode (periodic update based on distance interval)
4.	Transmission of Data on GPRS (primary mode of transmission), SMS (used as back-up).
5.	Facility to configure parameters over the air (should be supported over GPRS/SMS). These parameters include APN, Server IP or Fully Qualified Domain Name and port, Data Update frequency. Domain name registration service will be provided by [the Authority]. Firmware upgrade over the air should also be made possible.
6.	Data update rate to server (configurable): Multiple modes to be supported (ACTIVE, NORMAL and STANDBY)
7.	AVL system will support dynamic trip configuration, enabling the crew / control room to activate individual trips, provide route numbers for the UP or DOWN trips.
B	Operational Requirement
8.	The web-based system will be capable of data communication with all the system components in real-time.
9.	Uploaded data will not be deleted from device readers or workstations until the central system has provided confirmation acknowledgement that the transactions have been successfully received. All the data should be stored in the central database. 6 months of data to be available active and remaining in archive mode.
10.	The web-based system will able to update its date and time using time synchronization application of servers. Also the date and time on all system devices and workstations should also be updated.
11.	The ITS vendor will manage all device activity including data storage and processing.
12.	All active equipment will have an internally maintained date and time clock that is synchronized using a time interval via the communications medium with the system date and time clock.
13.	The systems will be driven by configurable parameters and should provide the flexibility for maximum configuration. The configurations will be for, but not limited to: <ul style="list-style-type: none"> ▪ Time based messages/reports ▪ User groups and users privileges

	<ul style="list-style-type: none"> ▪ Addition & deletion of equipment's, nodes, stations, user groups, users ▪ Configurable messages in minimum English and Telugu languages ▪ Reports access
14.	<p>The system will handle all degraded conditions which can be, but not limited to the following:</p> <ul style="list-style-type: none"> ▪ Any supplied equipment not functional ▪ Power failures ▪ Data connection lost ▪ Central server down ▪ Bus-station switch non-functional
C	Software location playback
15.	The vendor will provide all software and hardware that comprise the overall central system, including the required number of licenses for all users.
16.	The software will 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.
17.	The software will be accessed on workstations and control centers of all user identified by [the Authority]. All communications and AVL data will be stored in a manner that allows direct access by the software for at least 120 days and reporting data for 18 months live in the system. ITS vendor will provide Utilities to support archive and restore functions for older data.
18.	The system will allow replay for a single vehicle, selected set of vehicles or all vehicles or cluster wise vehicle or route wise vehicle on the selected map view for selected time period.
19.	The system will allow selection of any time period for the historical data. All data will be the property of [the Authority] and will be immediately available to [the Authority].
20.	The replay data will include location and headway adherence data.
21.	All users accessing the AVL software will be able to access the playback function.
22.	The system will allow the ability to use playback without exiting from the current AVL operational view.
23.	The system will be able to store a playback in a format that can be exported for viewing on any computer.
24.	All servers will be fully redundant and capable of automatic failover without administrator intervention.

D	Graphical Interface
25.	The central system shall be delivered with a fully functioning Graphical User Interface (GUI)
26.	The Graphical User Interface shall be based on standard web based browser controls or an equivalent system.
27.	The system will only be accessible by authorized persons, controlled using login and password protection. The login and password will be a single system for entire ITS modules. Role based access and SSO (Single Sign On)
28.	It will be possible to create different user classes/categories/roles with different access level.
29.	The system will maintain a transaction log that records all users that access system reports. The pages/reports accessed, edits and changes to the database and the system logon and logoff times. The transaction log will maintain this information for a minimum of one year. Minimum Concurrent User should be 2000
30.	The system security will provide features to maintain data integrity, including error checking, error monitoring, error handling and encryption.
31.	Features will be provided to ensure that all system-created files are uniquely identified, and that no files are lost or missed during data transfer.
32.	System will have verification features to confirm that there have been no losses of data at any point in the transfers.
33.	System needs to be tamper proof and ITS vendor would build features to confirm that there have been no unauthorized changes to, or destruction of, data.
34.	Features will be provided to automatically detect, correct and prevent the propagation of invalid or erroneous data throughout the system.
35.	All systems, sub-systems and devices will only allow access to authorized user classes.
36.	All security breach detections will be confidential, and accessible only to users of the appropriate class.
37.	For all data transactions, the system security will include authentication features to verify that all claimed source, recipient or user identities are correct and valid. All data transactions will include non-repudiation features to verify message content, and resolve claims that data was not correctly originated or received by a certain user.
E.	Maintenance Mode-Operational Requirement
38.	The web-based system and all the equipment (on-board equipment, PIS displays in stations etc.) will all support a maintenance mode during repair, replacement and testing of equipment.

39.	All the functions that are carried out in the maintenance mode will be reported separately similar to exception transactions
40.	The maintenance mode will be possible to be activated based on a particular node wise.
41.	The maintenance mode can be activated only by a person having the highest user privilege in terms of system operations.
42.	Logins and logouts will be transmitted to the system, along with associated Date/Time, employee ID, equipment ID etc.
43.	It will be possible to upgrade the firmware/ software from the central server using the internet communication available at the station level.
F.	Scalability/Future Operational Requirement
44.	The central software will be scalable to accommodate for buses, bus-station/BQS/terminal PIS, without any modifications to the central software except minor configuration changes, the details of how scalable the system is will be provided in the proposal by the ITS vendor at the time of SRS. The minimum scalability will be for 2000 Buses, 2000 PIS for BQS and Bus terminal, 50 bus depots and 30 UPTS. Authority will not pay any excess fees for increase in volume up to scalability.
45.	The software will provide standard reports based on the AVL data. ITS vendor will provide details in their proposal related to reports that are offered and the degree to which they can be configured (at minimum all report will be configurable for a specified date/time range and route). Some of the expected standard reports are as follows: <ul style="list-style-type: none"> a Headway adherence b Active fleet (weekday and weekend) c Service hours and mileage d Schedule Adherence e Speed Reports f Route Deviation reports
46.	The ITS vendor will facilitate the UCC to generate all the reports necessary to facilitate the payments to the bus operations team/contractor.
47.	The software will have the capability to generate reports based on exceptions as per thresholds set by the Authority/UPTS staff for various AVL components.
48.	The ITS vendor will provide tools to generate ad-hoc reports on stored AVL data.
49.	All reports will use standard reporting tools (e.g., RDBMS or SQL or Crystal Reports etc.) and will have the ability to export data into file formats that can be exported to and edited with standard tool i.e. excel, etc. The ITS vendor shall provide the relational database layout including related fields, key fields and definitions for all fields in all tables in the database.
50.	Any portion of the transactional database will be exportable in standard formats (such as comma separated variable (.CSV, xls, xlsx files etc.) for analysis in third party programs.

51.	It will be possible for users to build custom reports from the data in the transactional database with tools such as RDBMS or SQL. The reports will be capable to be exported to pdf, xls, xlsx formats easily.
52.	A data dictionary will be provided to Authority to facilitate development of custom reports.
53.	The Central System will provide sufficient summarized and detailed data including features to generate standard report based on pre-established criteria, as well as as-required reports based on a user-definable set of search criteria.
54.	All reports will be generated using a query language and standard query engine that provides flexibility for future updates, and for creation of new reports.
55.	Reporting software will include the ability to generate graphs and charts based on criteria and format defined by the user.
56.	All reports will 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.
57.	<p>The SI will provide an ad-hoc reporting function and interface into the data and reports server to allow Authority personnel to create, execute and receive custom reports without Authority assistance with integration with fare collection system. An Internet-based interface will be provided for this function, accessible by Authority personnel with appropriate permissions. Authority users will be able to generate ad-hoc reports and do additional analysis of ridership, revenue and other System data. The SI will provide Authority's staff to generate reports and use the system. Examples of the types of reports include:</p> <ul style="list-style-type: none"> • Transaction-level reports by stop and for user-defined start and end points; • Statistical and research reports using user-defined criteria
58.	<p>It will be possible to aggregate data (filter) for reporting, at a minimum, by:</p> <ul style="list-style-type: none"> • Date/Time • Origin • Destination • Location • Equipment Serial Number <p>It will not be necessary that values be consecutive for the purposes of aggregation (e.g. non-consecutive months).</p>
59.	The actual bus operational business rules will keep varying and Authority/UPTS will share the same with the SI from time to time and the vendor has to reflect it in the ITS application for generation of any additional reports etc. The cost of which will be deemed to be included in the monthly annuity cost.
G	Web Portal and Map

60.	The ITS vendor shall develop a Modular CMS based website. The user will be able to enter in the route, direction, station/stop ID or select these from a sequence of drill down lists and from a map.
61.	The ITS vendor will be responsible for the design and development of the website, including all required HTML, scripting, and integration with the AVL system. The ITS vendor will be responsible for the integration and setup of the website. The website GUI will allow for the graphical presentation of vehicle locations on GIS-based maps.
62.	The AVL software will 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 etc.). ITS vendor may use [the Authority] existing GIS base-map or Google map for this purpose
63.	The ITS vendor will provide a GIS based base map for the purpose of the project at appropriate scale which would be acceptable to [the Authority] operationally
64.	The system will include mechanisms to allow for 6 monthly updates by [the Authority] to the central software maps during the contract period
65.	Develop additional overlay map layers to the external source map that can 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.
66.	The software will allow users to view the map, including a selectable combination of the source map layers and new layers, at various user-defined zoom levels.
67.	The map display icon for each vehicle location to display as the label the vehicle, block or route.
68.	The display icon of the bus on the map will provide an indication if the latest reported location being displayed is older than the reporting interval or not, to identify packet losses and delay in communication transfer.
69.	The system will track headways at corridor stations for each individual route serving the station, all routes serving the station, and for any user-specified combination of routes serving the station.
70.	The system will highlight to the operator the vehicle IDs of those vehicles that are operating with incorrect headway, using tabular and map displays to indicate their current headway adherence status.
71.	The system will provide a real-time output of the current location and schedule adherence for all fleet vehicles, for use by the next stop prediction software. The ITS vendor will document and provide to [the Authority] the communications protocols, command sets and message formats used in this interface.

H	Real Time PIS Requirement: Prediction Software
72.	The system will use the real time location and schedule adherence data to create a continuously updated table and XML data feed of the last reported location for all vehicles and the next arrival predictions for all stations/stops.
73.	The system will provide this data table and XML data feed such that Authority 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.
74.	The ITS vendor will also provide a data dictionary and entity relationship diagram for the data tables and XML schema documentation. The information required by the algorithm(s) will be manually entered into a prediction support database.
75.	The system will allow the user to configure the prediction support database values.
76.	The percent error for next vehicle arrival time predictions at a given station/stop for a given minute in advance of arrival will be calculated as: absolute value of (predicted time to next arrival minus observed time to next arrival) divided by (observed time to next arrival). For example, if the observed time to next arrival was 7 minutes relative to a predicted time to next arrival of 8 minutes, the percent error would be 1/7 (i.e., 14%).
77.	The LED half-life (time until light output has diminished by 50% from the original rated value) will be a minimum of 100,000 hours
78.	Real time duplex communication to the PIS will be through the GPRS connection to the sign.
79.	The PIS will be able to display a message composed of any combination of alphanumeric character fonts and punctuation symbols. PIS will also allow Telugu and English fonts to be displayed simultaneously.
I	Documentation
80.	The documents to be developed include: <ul style="list-style-type: none"> a. Site and System Survey document that shall provide the understanding of the Bidder b. Hardware Design document that shall provide the solution of the bidder c. Software Design document that shall provide the details of the software, including the AVL Application Software as per requirements of Authority. d. System Requirement Specification (SRS) that will detail out the ITS vendor system design development, integration understanding and how they map with the requirements. e. Installation diagrams for all supplied equipment.

81.	<p>The vendor shall develop detailed test plans that cover the requirements. Test Plans shall be developed for all components of the project, including and would need to be approved by Authority:</p> <ul style="list-style-type: none">a. Bus Control Unit (BCU) FATb. PIS Display Board FATc. ALL Application Testingd. Software Testinge. Hardware Testingf. System Acceptance Testingg. Operations Acceptance Testing
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3.9.3 Automatic Fare Collection System

Electronic Ticketing Scheme

Electronic Ticketing System (ETS) would lead to collection of fares either through spot printed (ETM Issued) tickets via Electronic Ticketing Machine (ETM) or sale of manual tickets in-case of failure of ETM machines, and Smart Card Operations. ETS will consist of handheld ETMs used by conductors to automate Fare Collection by issuing spot-ETM printed tickets. Contactless Smart cards for travel (with e-purse for passes and tickets) will be procured in the near future for which the vendor (implementing the ITS project) will provide support and coordinate to ensure smooth functioning and validation of smart cards through the ETMs (as and when the smart cards are procured). As ETMs will validate e-purse smart cards in future, a provision must be made in the ETMs for a smart card reader with inbuilt security protocols and modules to integrate fare with other modes such as Metro etc. The ETS will support secure transfer of financial data from ETM through GSM network to a central server at preconfigured intervals. Detailed ETS features is explained as follows:

1. The Electronic Ticketing Machine should facilitate the following tasks:

- a. Bar Coded paper ticket sales
 - b. Bar Coded paper ticket adjustment
 - c. Smart Card Validation
 - d. Smart Card Balance Check
2. The ETM's shall be connected to the central system through mobile connection and the Bidder shall bear all cost for such connection during the entire contract period
 3. The ticket data should be communicated online from ETM devices to backend over GPRS/USSD using encrypted protocols and should automate revenue reconciliation data
 4. The handheld machine shall consist of but not limited to smart card reader, bar-coded ticket printer, integrated communication modem, user interface (e.g. touch screen or screen with keypad), on board data storage, and battery power supply.
 5. The user interface shall allow an experienced conductor to issue a ticket in less than four (4) seconds.

6. The handheld machine shall allow TSRTC to transmit data to the central system in real-time using the integrated modem.

7. User Interface

- a. The handheld machine shall have an integrated display that can be easily read under all conditions of ambient light throughout the day and night.
- b. It shall be possible to upgrade the firmware/software from the central server, configuration list such as routes along with fare and other related details etc, data from and to the CCC Over-The-Air (OTA) using the wireless technology.
- c. If for any reason the fare media cannot be read automatically using the readers on the handheld, there shall be an arrangement to manually enter the smart card ID and validate it.

8. On-Board Storage

- a. The handheld machine shall store all required transaction data on-board, including:
 - Date and time of transaction
 - Device ID
 - Employee ID of conductor
 - Fare-tables
 - Ticket serial number
 - Ticket origin
 - Ticket destination
 - Transaction Value
 - Action taken (e.g. ticket sold/adjusted/checked)
 - Smart card serial number (if applicable)
 - Transmission Status (i.e. successfully transmitted/not successfully transmitted)
- b. The handheld machine shall have sufficient memory to store a minimum of one-week worth of transaction records apart from mandatory software/ firmware etc.
- c. Only successfully transmitted transaction data records shall be overwritten by new transaction data records
- d. The handheld machine shall provide a warning when the amount of on-board storage occupied by “not successfully transmitted” transaction data records exceeds TSRTC specified threshold
- e. The handheld machine shall store the current valid fare-set as well as a future “pending” fare set with activation date and time (if applicable), to allow downloads to the handheld machine to occur in advance
- f. When the activation date and time passes, the revaluing unit shall automatically replace the existing fare table with the “pending” fare table

9. User Login

- a. Initiate handheld machine operation, a conductor shall manually enter an employee ID and a PIN, or a proximity standard
- b. Logins and logouts shall be transmitted to the central system, along with associated Date/ Time and employee ID
- c. The handheld machine shall be used by mobile ticket conductors to sell tickets to customers
- d. The tickets issued shall comply with all requirements laid out in the relevant sections
- e. The conductor shall be able to manually adjust the current origin location
- f. The origin shall be set only once whenever it is changed so that the conductor needs to enter only the destination of people until the next origin is reached
- g. To sell a ticket using the handheld machine the conductor shall, upon receiving payment, enter the destination using the interface (using the current origin which is periodically adjusted manually by the conductor)
- h. The handheld machine shall then print the ticket for issuance to the passenger
- i. The system shall provide the ability to add a configurable fine (either optional or mandatory for use by the conductor) to a ticket by pressing the appropriate buttons on the handheld machine interface (for example, if a new ticket must be issued because a customer does not have a ticket or has an expired ticket)

10. Smart Card Usage on the ETM

- a. The handheld machine shall have a trip validation functionality whereby when a smart card is tapped to the reader, the ticket origin and date/time of the tap-in is displayed on the handheld device display.
- b. Upon successful completion of the transaction the handheld machine shall transmit transaction data to the central system, including:
 - Date and Time of Transaction
 - Device Identification Number
 - Ticket Serial Number
 - Ticket Origin
 - Ticket Destination
 - Smart Card Serial Number
 - Upon successful completion of the transaction the handheld machine shall indicate successful completion via the interface, using both the display and a distinct configurable audio message.

3.9.4 Business Intelligence Platform for Reporting

BI platform shall enable the TSRTC to build reports from operations data to perform multi-dimensional analysis enabling to have better insight into parameters and enable TSRTC to take business decisions leading to higher operational efficiency. The BI tool hence should offer the following functionalities:

A. Management Dashboard

1. Display information in an easy-to understand format and use intuitive and interactive visualization to enable management users within TSRTC to quickly navigate, understand, and investigate data elements to make informed decisions
2. Allow users to capture and export the current display through electronic reports and in different printer-friendly formats, including, at a minimum, MS-Excel, PDF, and Web formats
3. Have a default configuration and landing page for each user or user-group that are editable
4. Allow multiple visual elements to be laid out on the same display
5. Have the ability to display dashboards and reports using different visual elements including charts, maps, calendars, gauges, images, tables, visual and textual lists, and alerts as follows
6. Maps shall allow plotting different mark-ups and indications on a map view using base and spatial map layers and allow the user to zoom and pan freely through the map, and be able to present heat map visualizations on GIS data
7. Calendars shall allow the user to intuitively navigate through calendar fields, such as day, month, and year
8. Have view-management tools, allowing the user to move, reorder, enlarge, shrink, open, and close visual elements with intuitive interaction.
9. Allow the user to create a new visual element based on the available visual element types and customize an existing visual element with an easy-to-use graphical interface.
10. Allow the user to save any customization done on a visual element.
11. Have zero-programming mashup capability that allows the user to configure queries and data mashups visually through drag-and drop functionality.
12. Allow the user to drill down to display increasingly detailed data on various data elements
13. Allow intuitive visual filtering, focusing, and selection of the displayed data and information
14. Allow the user to filter and sort the presented data based on a number of attributes including the time period or on multiple attributes simultaneously
15. Allow the user to search through visual elements that display numerous data entries such as tables and lists
16. Understand different types of structured data including numbers, percentages, fractions, general text, coordinates, and objects
17. Have the ability to mashup different types of data from multiple sources with automatic detection of relationships between the data components and an option to manually define/overwrite relationship
18. Run mathematical, statistical, and analytical operations on available data

19. Compute trends and projections from data based on available historical data and based on data from external systems to enable informed decision-making

B. Searching & Filtering

1. Allow the user to drill down and search through the large amounts of data easily and quickly by time periods and other search criteria defined by the user. Also, provide user guidance for searching & filtering through data
2. Generate reports from the current view in different electronic formats including at least MS-Word, MS-Excel, PDF, and Web formats and that are printer-friendly Not require programming knowledge or knowledge of SQL or databases to perform searches, queries, and filters
3. Display a huge amount of data in a clear and organized view
4. Allow the user to hide or show parts of the data
5. Offer the capability to search multiple data sources effortlessly through a GUI
6. Allow the user to search, filter, and sort the presented data based on any attribute or on multiple attributes simultaneously
7. Allow the user to graphically define complex queries that contain multiple parameters and span different data sources.
8. Allow the user to search through historical data
9. Allow the user to save the current queries, filters, and selection parameters
10. Have data-pivoting capabilities
11. Understand different types of structured data including numbers, percentages, fractions, general text, coordinates, and objects
12. Store saved custom queries

C. Reporting

1. The system shall have the ability to allow the user to generate reports based on predefined report templates or by manually selecting the data and the corresponding visual elements
2. The system shall have the ability to provide a GUI with drag-and-drop functionality for creating custom formatted reports that include visual elements, objects, and formulas
3. The system shall have the ability to Display the list of available report templates, saved reports, and recently used report templates when the user logs in
4. The system shall have the ability to Allow the user to create, load, modify, delete, and save report templates graphically
5. The system shall allow reports to be generated and published on an ad-hoc or scheduled basis with the ability to predefine a list of recipients and a regular schedule through a GUI
6. The system shall be able to generate reports in different electronic formats including at least MS-Word, MS-Excel, PDF, and Web formats and that are printer-friendly
7. The system shall allow reports to be sent directly to a network printer
8. The system should have the ability to generate planning and forecasting reports for providing the information related to planning for no of buses to be transported
9. The system shall have the ability for the reports to have the ability to drill down to multiple levels
10. Reports should have the ability to print

11. Publish reports and dashboards for planned Vs. actual data, for example the system should allow the management user to view the planned budget vs. the actual revenue spent for a particular route
12. The system shall allow to publish reports and send them to recipients through email attachments and to a central data store to be accessed by different users
13. The system shall allow conditional formatting, based on thresholds or data ranges, for any cell/object in the report
14. The system shall allow the display of multiple data elements and result sets in the same report
15. The system shall allow the user to display historical data side-by-side or overlapping in views where applicable
16. The system shall display the generated report on screen

D. Data Retrieval and Management

1. Provide fast, secure, reliable, and easy mechanisms to retrieve information and data from the different data sources to meet the dashboard KPI requirements
2. Provide different mechanisms for retrieving data from different data sources including ETL, File Transfer, and Real-time integration
3. Log all received information from entities
4. Allow the user to define and connect new data sources and data stores effortlessly through a GUI

E. ETL (Extract, Transform, Load)

1. Perform ETL to extract, transform, and load operations to move the data from internal and external data sources to the staging environment and from the staging environment to the Storage environment
2. The system shall have the ability to perform multiple transformations on data including but not limited to: Selection, Translation, Encoding, Derivation, Sorting, Joining, De-duplicating, Aggregation, Transposing, Splitting and Lookup
3. Provide the ability to define, configure, and manage ETL jobs
4. Support import and export wizard and supporting connections with source and destination adapters including but not limited to OLEDB, flat files, and XML formats
5. Have scheduling capabilities based on time, events, and triggers
6. Provide a user-friendly GUI to allow the user to handle ETL processes including:
 - a. Modifying data feeds
 - b. Changing of business logic used for data ETL
 - c. Modifying ETL parameters
 - d. Creating
 - e. Editing
 - f. Executing a large number of transformation rules
7. Allow the user to search, filter, and sort the data by stage, source, and type
8. Allow the user to search the metadata
9. Support batch data extraction, transformation and loading
10. Store ETL rules and schedule

11. Store the data at different stages including the raw data
12. Real time integration with data source:
 - The system shall have the capability to integrate with data sources on the real time basis to fetch the information
 - The system shall be able to quickly retrieve the data with minimal time lag
 - The system shall have the ability to capture the failed transaction
13. File Transfer
 - The system shall support data retrieval through transferring files automatically using secure file transfer protocols such as the Secure File Transfer Protocol (FTP over SSL) protocol.
 - The system shall support automatic file upload capabilities that can detect a new file and upload it
 - The system shall automatically rename the uploaded file to a proper filename including the source, date and version, based on configurable file-naming rules
 - The system shall properly manage duplicate submissions by keeping the old file and applying proper versioning and renaming
14. The system shall allow the Backend Users to view file transfer history with filter and sort capabilities
15. The system shall perform quality management on data provided through file transfer including validation and verification of file type and size and return errors and required corrections accordingly
16. The system shall be able to receive and store large files as specified in the configurable file transfer rules

F. Data Quality Management

1. Perform data cleansing, verification, validation, and reconciliation automatically and based on defined rules
2. Allow the user to manage the data quality process workflow and rules using a GUI
3. Compare the data to historical data as reference data for detecting anomalies
4. Rank the completeness and validity of the processed data
5. Store data quality verification rules and process workflow
6. Store historical data
7. Data Stores
 - Retrieved data from different data sources should be temporarily stored and processed in separate Operational Data Stores (ODSs)
 - Data used to perform visualization, reporting, and searching operations should be stored in appropriate Storage environment (e.g. Data warehouse)

G. BI Configuration and Management

1. The system shall allow the authorized user to complete the following functions:
 - Manage the different KPIs available by adding, modifying, or deleting KPIs or KPI groups areas using a GUI

- Enable or disable KPI which activates or inactivates it but does not delete it (soft deletion)
 - Configure a KPI including its ID, name, description, area, data source, format, unit, frequency, and formula
 - Configure the user access level required to view each KPI
 - Choose the default and alternate views for displaying a KPI
 - Drill down by clicking on a KPI to view its details and edit it
 - Search, sort, and filter KPIs by ID, name, frequency, measure, and indicator area
 - Show/hide disabled KPIs from the KPI management screen
 - Manage data sources for the KPIs easily through a GUI
2. The system shall have the ability to present an intuitive GUI allowing the authorized user to configure the threshold values and levels (green, yellow, red, or as defined per management preference) for a KPI by defining score card algorithms
 3. The system shall have the ability to clearly present multiple KPIs in the same view
 4. The system shall have the ability to Configure KPIs that are aggregates of multiple other KPIs from different areas
 5. The system shall have the ability to instantly and automatically update the other dashboard components with any new KPI or changes to the configuration of current KPIs
 6. The system shall have the ability to Store each KPIs current and historical measure
 7. The system shall have the ability to Configure KPIs with multiple data sources
 8. The system shall have the ability to run algorithms to calculate the measure of a KPI based on data from subset KPIs
 9. The system shall have the ability to Store the different access levels for each of the authorized users

H. Dashboard and Reporting Requirement for ITMS

The list of reports given below is partial list and is being provided for the sake of understanding from the perspective of providing insight into the type of solution required to meet TSRTC's business process requirement.

List of Daily Reports needed for the service performance monitoring:

1. Category: Bus Maintenance and Availability

- **Bus Availability**
How many buses are available in the depot at the beginning of the shift daily?
- **Bus Breakdowns**
How many buses are in the workshop for repairs, how many buses breakdown during while in service? When multiple routes are operations, this information will be needed per individual route as well
Bus kilometres between two breakdowns of same bus (individual bus wise)
- **Bus Maintenance**

Individual Bus report consists of preventive maintenance and all other work done on that bus with kilometers

- **Schedule Adherence of individual trip of bus**

Scheduled adherence report based on published schedule and actual schedule. Ability to sort the report by the operator by the trip will be useful

- **Operational Issues on Field: Bus bunching etc.**

Incident reports to be generated based on information gathered by the control room on a daily basis. These reports should have bus number, trip number, operator number, time of the day, type of incident

2. Category: On time Performance

Definition of On Time Performance will be finalized in consultation with TSRTC. Time Points within individual routes will be introduced for OTP. For all OTP, need % early, % OT and % late.

- **Scheduled KM by trip versus Actual KM by trip and Summary for day**

The report will have scheduled kilometers against actual kilometer by trip and by day. When multiple routes are operational, this information will be needed per individual route as well. The report should generate missed trips or missed kilometers per individual routes

- **On Time Performance (OTP) for Individual Trip**

System and trip on time performance report for individual routes and feeder routes.

- Daily peak, base and evening performance OTP
- Cumulative daily performance OTP
- Weekdays and weekend performance OTP
- Waiting time of bus at the junction and time to clear the junction during off peak, medium peak and peak hours.
- Speed of a bus between stations
- Speed Violation

3. Transit Performance Measures

Service Offered/Utilization		
1.	Average Total Ridership	Total no. of passengers travelled in a month / No. of days
2.	Total Monthly Ridership	Total number of passenger travelled in a month
3.	Average Trip Length • Week Day • Week End	Total of (Passenger * KMS travelled) in a day / Total passengers travelled in a day
4.	Vehicles operated in Maximum Service / day	Total no. of buses operated during peak hours
5.	Vehicle utilization / day	Total KMS travelled by a bus in a day
Economics		

6.	Passenger / Revenue km	Total passengers travelled in a bus / total revenue KMS of buses in a month
7.	Fares / revenue km	Total fare collection in a month / total revenue KMS of buses in a month
8.	Vehicle Operating expenses / revenue km	As per contract
9.	Operating Ratio	Cost per bus/ Earning per bus
10.	Staff/Bus Ratio	Total Staff Utilized for each bus operations
Availability		
11.	Service Coverage	As per the route in operation
12.	Frequency of Buses <ul style="list-style-type: none"> • During Peak • During Medium Peak • During Off-Peak 	
13.	Hours of service	No. of operational hours of buses
14.	Average waiting hours for users	
Convenience		
15.	Passengers/Trip <ul style="list-style-type: none"> • During Peak hours • During Off-Peak Hours 	Total no. of passengers in a day / Total no. of trips of buses in a day
16.	Dwell Time	Avg. dwell time of buses at bus stops
17.	Load Factor	$(\text{passenger-km} / \text{capacity-km}) * 100$
18.	Fatality rate/km	Total fatalities / total length of designated route
Vehicular Capacity		
19.	Bus Capacity	Designated Capacity of Bus
20.	Bus Lane Capacity	Passengers in peak hour peak direction
21.	Volume-to-capacity ratio	Comparison of capacity usage

I. Dashboard and Reporting Requirement for AFCS

The list of reports given below is partial list and is being provided for the sake of understanding from the perspective of providing insight into the type of solution required to meet TSRTC's business process requirement.

List of Daily Reports needed for the service performance monitoring:

1. Category: Station and Passenger Information

- **Arrival and departure per station by individual trip**

The report should be generated to give arrival and departure information per station for individual trips. Then for each station, the average dwell time should be calculated and measured against the total number of boarding if available

- **Using Handheld Ticketing Machine**
 - Origin and destination of a trip and length of trip
 - Boarding and alighting information by individual stations by direction of route
 - No of trips per day and per month
 - Per station Revenue
 - Per Bus Revenue
 - Ticket Consolidation report
 - Settlement

3.9.5 Vehicle Scheduling and Dispatch System

The system should have ability to optimize the complete service delivery by developing the route network and publish final timetables & rosters, generate informative statistical summaries and MIS from the system, handle multiple vehicle type like AC buses, ordinary buses, long route buses etc.

1. Proposed Solution should have following integrated functionalities/tools from same OEM and should offer complete integration capability with other operations management system like AVLS, AFCS etc.
 - Network Plan & Timetables
 - Trips & Vehicle Planning
 - Crew Schedules
 - Roster and Dispatch (Operations)
 - Crew Kiosks
 - Performance monitoring
 - Workshop & Fleet Management System
 - Fuel Management
 - Tyre Management
 - Procurement & Inventory Management
 - Capability to scan and upload documents like License, purchase order copy, etc. into corresponding sub systems and use this information for compliance purposes.
2. The proposed system shall provide feature for creating vehicles in one depot and process for transferring vehicles to other depots including features to capture trip/schedule wise revenue kilometer. The system shall also have following feature:
 - Capability to capture dead kilometers in the solution.
 - Define and create Charter trips into the system
 - The charter trips should be reflected into the operation module for rostering and dispatch functions.
 - Capture requirements from customer for chartered trips into the system.
 - Make changes in routes and bus stop locations due to traffic management (traffic police) changes (one way streets, construction, etc.)

- Create users in the system
- Assign roles, access and user permission in the system port user defined event definition for sending alerts and message
- Send alerts and email based on certain conditions/events/transaction.
- All modules/sub modules of Depot management should be seamlessly integrated
- Support in deriving efficient vehicle assignment by route minimal repositioning/dead runs
- Should have integrated Optimization Tool for vehicle and crew based on various constraints and preferences
- Generate “what-if” scenarios.
- Support drag and drop for network planner; undo and redo; search.
- Provides the costs associated with each service option
- Produce printouts of crew schedules, duty rosters, route timetables, bus stop timetables etc.
- Generate On-demand statistical reports and summaries
 - Ability to generate Reports such as
 - Statistics Report - Headway, Running times for each trips.
 - Running Boards - Time table of each RUN
 - Arrive Depart Graph
 - Timetable reports - to be displayed at bus stops
- Import master data such as with its respective GIS data to the Map, Vehicle data etc.
- Additional reports as per request
- Provide facility to export data/reports to in pdf, excel /.csv /XML or HTML formats
- Perform trip time deviation analysis to find where the critical trips.
- Support for constraint analysis to find where the critical constraints are
- Save documents like birth certificates, education certificates, license, offer/ appointment order, etc.
- Solution should support following MIS Reporting
 - Crew allocation
 - Schedule allocation
 - Crew utilization report
 - Fleet departure at depot
 - Fleet dead KM per route/ fleet wise
 - Revenue kilometer
 - Schedule or trip cancellation
 - Crew license renewal history
 - Over time details per staff wise
 - Fuel stock per month/ week/ per day
 - Fuel consumption every day
 - Fleet wise fuel consumption
 - Vehicle service alerts

3. Network Plan & Timetable

Proposed solution should be capable to interface with GIS Maps.

- Calculate distances between associated points defined as stop / terminus / depot on the GIS Maps.
- Network planner or map interface that allows the user to define stops, terminus and depots on the map
- Ability to link various nodes (stops, terminus etc.) with paths to create a graphical route network that is easy to understand
- Create, edit and modify depots, stops and terminus in system
- Create routes and timetables for both inbound and outbound directions.
- Track and minimize dead runs
- Add/view Average Speed / Distance
- Add/modify/delete/undelete/view Vehicle Type.
- Create timetable, adding and modification of trips, assigning the vehicles to the trips thus creating a vehicle schedule.
- Construct crew schedules by integrating with the vehicle schedule.
- Create vehicle schedules with split into a set of shifts, allowing the split to occur only at the relief points, a place where a crew may handover the bus to another crew.
- Create a new route
- Edit an existing Route
- Add turn restrictions
- Remove Turn restrictions
- Enable / disable turn restriction
- Set to One-way
- Set to Two – way
- Set to Blocked Road
- Define Road Class - Main roads, highway, narrow road, freeway, toll road etc...
- Authorized user should be able to create Road speeds for various road types
- Authorized user should be able to add nodes / points. With identified with unique Id. As Bus stops, Bus terminus, Time points, Meal place, Depot, Relief points etc.
- Only Authorized User should be able to delete nodes / points.
- For each of the nodes / points added, user should be able to add name for public timetable.
- Add Longitude and Latitude coordinates for nodes / Points.
- Indicate type of shelter for a bus stop
- Capable to define vehicle types which can stop at this location, if it is a bus stop
- Ability to create and add multiple type of buses - single decker, double decker, mini bus, multi axle bus etc.
- Create a Path - user should be able to
- Define route/path with unique path ID / name for it
- Edit an existing path by choosing the path id / name

- Create Route/Path with repositioning/z-path, start point and end point with or without
- GIS MAP
- Adjust the route/path to consider the roads and shortest distance the bus has to perform the journey
- Copy and duplicate an existing path
- Add, remove or modify nodes on the path
- Create a multiple path with a combination of one or more paths
- Define inbound and outbound routes
- Ability to automatically create a reverse/return path with the same attributes and details as in the original path
- Choose a Vehicle type or types for a particular path
- Allow an authorised user to delete a path or a multiple path
- Identify and edit Travel distance, Travel time based on GIS information and Average
- Speed defined by user for the entire path / route or specific nodes/stops.
- Define and edit the speed for the entire path / route or specific nodes/stops
- Create on the MAP dead run path from a specific depot to any bus stop of a path
- Auto create dead run path from any of the depots to any bus stop of a path and what if analysis
- Define and Edit the speed, Travel time, Travel distance for the entire dead run path
- Allow user to combine a path and the dead run path to be part of an inbound /outbound route path
- Handle multiple depots and optimize schedule across depots
- Optimize fleet results against depot and vehicle constraints
- Ability to edit Running Times in
 - In table view
 - Using graph
- The Fleet/vehicle module should support
 - Multiple day types – like Week Day, SAT, SUN, Holidays etc.
 - Timetable - inbound and outbound paths
 - Add trips - inbound and outbound paths
- Ability to View trips by
 - Tabular Format
 - Graphical/Zig-zag view
 - Horizontal view
- Ability to define multiple day types for the entire calendar year or a specified period for weekdays, Public Holidays, School vacation, Saturdays, Sundays and any other combination of days (like 2nd Saturday) etc.
- Ability to define and link route/path to a specific day type time table – weekdays, Saturday, Sunday, Holiday etc.
- Map should feature's such as PAN, Zoom-in, Zoom-out etc.
- User should be able to print the below reports

- Graphical report for a Path / Route
- List of Nodes / points with the relevant details
- Graphical report for a path / route with different travel times for different time periods in a day
- Public Time Tables

4. Trips & Vehicle Scheduling

Solution should have ability/edit specify inbound and/or outbound timetable for a specified day type.

- Allow user to define the path type for the time table - circular, loop, Radial etc.
- Add, edit and copy/duplicate timetables
- Only authorized users should be able add, edit or delete timetables
- Link/add trips to the selected timetable.
- Add trips automatically to the time table based on start time, end time, number of trips or headway
- Modify any / all trip running time, running distance, add new time points, truncate any of the trips and save the changes
- Allow user to join / unjoin the trips based on ending or starting within a time gap
- Join/unjoin trips in manual, assisted and auto mode.
- Allow user to split the trips in a time table
- Support multiple methods of viewing the trips, paths and nodes / bus stops and to switch instantaneously between the views.
- Add, edit, delete and copy/duplicate a Bus schedule for a day(s) in which buses have to operate trips as per the selected inbound and outbound timetable (s) and include a user defined name to it
- Allow an authorized user to add, edit, delete and copy/duplicate a bus schedule.
- Ability to link all the inbound and outbound trips in manual, assisted and auto mode.
- Ability to indicate the number of buses required to operate all of the trips upon complete linking of all the trips.
- Ability to provide appropriate error messages in case layover times and Dead run timings do not match in the time tables.
- Solution should have ability to Minimize shifts
- Ability to Minimize mixed shifts
- Ability to Minimize costs
- Ability to minimize Total spread of hours of running
- Ability to Minimize number of continuous driving segments
- Solution should have ability to Avoid idle time of bus during AM peak, PM peak
- Ability to Minimize dead running KMS
- Solution should have ability to Minimize layover time at Depots, meal points/Relief points
- Ability to suggest minimum vehicle required for the schedule.
- Ability to Maximise or minimise the bus running hours

- Ability to display exceptions such as trip without any bus
- Ability to split, Join, Merge and Renumber RUNs
- Ability to duplicate RUNs
- Ability to colour code trips
- Ability to link /unlink buses to trips
- 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 of schedules of a route/multiple routes
- Ability to identify relief points where crew can interchange and have meals.
- Ability to pick and drop crew at relief points/depots as per the schedule.
- Solution should handle the schedule for these pick and drops using either fleet of vehicle dedicated for crews or public transport.
- Ability to provide multiple MIS and reports from the System, such as:
 - For Time table
 - by Path
 - by Route
 - by start time
 - by end time
 - by trip number
 - by day(s) of the week
 - by distance
 - by speed
 - Bus Arrival and departure summary from a depot
 - Bus RUN summary report with or without time points / bus stops for day(s) of the week with statistics data on Running KMS and time, Dead Running, Idle time, recovery / layover time,
 - Number of buses operating in traffic from a depot spread over 24 hours

3.9.6 Crew Schedules

- Solution should be capable of meeting the existing Rules of crew duties.
- Create crew schedules considering different shifts parameters such as shift spreads, meal time etc.
- Create crew scheduling as per the Motor Vehicle Act.
- Define relief points.
- Define shift start and end points
- Define relief points and duties with travel to these points by walk, bus, Metro or by staff bus.
- Ability to consider the different modes of transport and the time taken by each mode while creating crew schedules
- Ability to consider the travel time to relief points with multiple mode of travel In case relief points and shift start location is different locations.

- Ability to minimize the duty spread
- Ability to Minimize travel time from relief points to depot / meal locations
- Ability to minimize breaks between 2 blocks of service
- Ability to Schedule duties such that the last portion of duty shall close at a particular depot
- Ability to ensure minimum hours are worked before a meal break or an extra break
- Ability to ensure minimum hours are worked before an extra break
- Solution should be capable of creating crew schedules for Bus schedules which operate from a specific depot / group of depots or from all the Depots
- Capability to create crew schedule including/excluding certain Route Numbers
- Capability to create crew schedule considering a specific meal break location for a particular Route Number / selected route numbers
- Ability to view, edit or allocate crew to a schedule
- Ability to re-adjust Constraints / preferences rules for a depot or the entire depot and rerun the Crew schedules
- Solution should be accessible by all Depot authorized users to download the Crew schedules created by the system
- Solution shall enable the user to define rules, including:
 - Relief points (driver changeover points)
 - Vehicle depots
 - Meal places (may be a vehicle depot)
 - Modes of travel (e.g. walk, staff car, etc.) to and from relief points and depots
 - Shift types that can operate a service, e.g. straight, broken or part-time
 - Rules for legal schedules
 - Ability for optimizer to number driver shifts in a user defined numbering pattern

3.9.7 Reports from the System

- 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.
- Consolidated Crew report for all duties in a depot for day(s) of the week clearly indicating
- Sign On, Sign Off, On vehicle, OFF vehicle, Steering time and hours of duty for driver and conductors
- Statistics reports of crew and depot.
- Horizontal Blocks to provide duty wise details of each crew along with the Route number on which they will perform duty

3.9.8 Rostering

- The Bidder shall provide a Crew Rostering Software, already used by Public Transport Operators.
- The Software shall have provision for creating the Roster as per Rules, Acts and statutory requirements.

- Crew Rostering module shall be able to create group of users based on set of defined parameters.
- The proposed rostering module shall plan and generate the rostering automatically for next one month to one year.
- It shall allow admin or authorized user to create and view the planning for a week/month before it applies to real production.
- Solution should have provisions to easily make changes to the planned roster
- Solution should have provision to create rosters for user definable day types such as Public Holidays, weekends etc.
- Solution should have capability to automatically rotate crew as per the user definable parameters
- Ability to create groups and types of crew.
- Ability to assign crew work/duties based on user defined groups
- System should have provision to include non-driving work in the roster
- Solution should have provision to utilize drivers from other Depots
- The proposed rostering application shall display or provide rostering using graphical representation for the selected period
- The Rostering module shall interface with scheduling module to assign crews automatically to the schedule.
- In case schedule is cancelled then rostering shall update crew's operation hours, ideal hours, etc., for day to improve the operation.
- Rostering shall have technique to minimize and help purchaser in identify the nonperforming /
- Under performing crew.
- Scheduling module shall support purchaser to assign the vehicle to particular schedule and number of trips. Forms and acts applicable to purchaser shall be incorporated into the scheduling & rostering module.
- All schedule shall be identified by schedule number and/or start and destination name.
- 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.
- Scheduling module shall allow admin or authorized user to update, modify or cancel the schedule.
- It shall also allow user to cancel particular trip that means partial schedule cancellation.
- The proposed application shall allow users to modify/update the schedule quickly.
- Various MIS reports to support shall be provided. The reports include, but are not limited to:
 - Distance Reports
 - Depot Reports
 - Station Reports
 - Route Reports
 - Form-4 Reports
 - Anomalies Reports
 - Dead Kilometre Reports
 - Comparative Reports

3.9.9 Dispatch/Daily Operations

- Ability to plan dispatch of depot vehicle using a depot Plan
- System should have functionality and provisions to establish Crew Biometric and smart card based Kiosk, this should be fully integrated with Rostering and Dispatch
- Proposed solution should manage multiple Depots from the one screen
- Data from multiple should be available one screen for operations manager/starter to make decisions.
- The Dispatch module should be fully integrated and have availability of vehicles in real time from workshop.
- The solution should have ability to display the current and future duties to be performed by the staff.
- Solution should have provision to easily swap work between crew.
- Solution should have provision to Easily sway work between vehicles
- Solution should have provision to handle on-road vehicle changes due to accidents, breakdowns etc.
- The solution should have provisions to capture driver licenses and other statutory documents
- System should alert various stake holders including driver in case the document has expired and need to be renewed
- Solution should have provisions to manage crew contact details
- Ability to volunteer for additional work by crew from the crew kiosks
- Solution should have detailed shift information available to operations manager/ starter
- Solution should have ability to change how many hours are required by crew to perform a duties and highlight the overtime in case it is required
- Solution should highlight the workshop plan and vehicles required for workshop maintenance for the period
- Solution should have capability to send the SMS messaging to crew, either in bulk or individually
- Ability to send SMS alerts if crew late for work
- Ability to send SMS alert to crew if work has changed
- System should flag and give Late crew popup alerts
- Ability to sort vehicle / drivers as required
- Solution should have ability to incorporates Charter work
- Ability to apply skill restrictions at a Shift or vehicle level
- Gate processes for Vehicle In/Out from the Depots shall be captured in the system.
- Depot manager shall be provided real-time information and reports on staff presence from the system using the Proximity reader data.

3.10 Intelligent Transit System - Technical Specifications

3.10.1 Vehicle Tracking Control Unit

VTCU device can be installed in the JNNURM buses, Metro Express/Deluxe buses and other buses operating in long distance routes, identified for this purpose. A total of about 150 devices shall be provided by the vendor, duly taking into consideration the GPS equipment already available in JNNURM buses. Below mentioned are the minimum hardware specifications of the VTCU. The successful bidder shall however make use of the GPS Vehicle Tracking equipment already available in 25 JNNURM buses, wherever possible.

A	GPS Based Vehicle Tracking Unit (IN Built In All UBSII buses)
1.	The GPS based VTU already installed on all JNNURM buses (around 25) Other buses where VTU is not installed are around 89
2.	GPS Based VTU will update the location information like Latitude and Longitude to the central server through GPRS.
3.	<p>The tracking system / GPS Based VTU fitted in the buses will calculate the positions from the GPS receiver and transfer the data to the Control Centre Server through GPRS interface for processing /prediction of arrival time of buses at different bus stops. The GPRS tracking unit fitted in the bus will also transfer the current LON/LAT data to the bus mounted display for display /audio announcement of Bus Stops.</p> <ol style="list-style-type: none"> 1. VTU should capture a minimum of GPS (Location, speed, heading or direction, timestamp) 2. Data sending frequency of less than or equal to 10 sec or configurable 3. Capability to send Network measurement report (NMR) 4. VTU memory to store minimum of 24 hours (One Calendar Day) of movement data and until it is transmitted to the server for that day 5. The Tracking Unit should have position accuracy of 5 -10 m. 6. Should provide the Data communication protocol, listener API and associated software and database applications so that the VTU data can be received at central server and data outputs as per NMEA 0183 format. 7. Remote Configuration, activation, status alert, deactivation of device and alert for disconnection of main power from VTU by SMS must be available. 8. Tamper Proof, Vandal Proof and Water Proof enclosure (IP65 and above) for GPS, internal antenna and power supply must be provided with metallic casing for the unit, metallic tube covering the power supply 9. The device should operate on 9V-35V vehicle battery. The unit should also have an internal back-up battery (8 hours) and the battery charge should be indicated in the unit. 10. Three year warranty for the equipment's 11. Hot Start < 5s 12. Warm Start < 40s 13. Cold Start < 60s

	<p>14. Temperature range: -10° C to 70 °C 15. Humidity Level: 5% to 95% non-condensing 16. Operating temperature: 0-60*c 17. Sensitivity: (-) 158 dB</p> <p>Ports:</p> <ol style="list-style-type: none"> 1) I/Os: A provision to be made for Inputs and Outputs relays, sirens etc. 2) Ignition sensing 3) RS232 ports (2 ports) 4) USB ports (2 ports) <p>Power Specifications</p> <ol style="list-style-type: none"> 1) Input voltage range 9V - 35 V 2) Active mode Peak <= 1.0 A 3) Active mode Avg <= 200mA/; Intelligent power management system 4) 8 hours or more of Battery Back Up 5) Sleep Mode <= 25 mA
<p>4.</p>	<p>The GPS Based BCU with wireless communication module (based on GPRS) shall be used to provide vehicle tracking accurately and reliably. The following are minimum list of features required:</p> <ol style="list-style-type: none"> a. GPS based VTCU will consist of a GPS receiver with inbuilt GPS Antenna, GSM/ GPRS receiver, etc. to enable services such as vehicle tracking, communication and control in connection with a backend control centre system. b. The device is pre-installed on each City Bus fleet vehicle and integrated with all the other in-vehicle ITS functions and hardware being installed (e.g., Automated Stop Announcement Variable Message Signs and Public Address amplifier with speakers, Cellular Data Modem, Transit Signal Priority Emitters, Bus Door Sensors), and will support the data transfer to/from the central system through a commercial cellular data network. c. GPS Based VTCU will be mounted inside the vehicle and shall be vibration & shock resistant, heat resistant, dust resistant and water / rain splash resistant and shall be tamper proof. It should as per to relevant Indian or International standards. The detail specification of BCU will as per JnNURM II i.e. http://jnnurm.nic.in/wp-content/uploads/2013/01/Chapter-10-ITS.pdf d. The device will be operated from vehicle battery connection but will preserve battery life by tying its operation and that of the other on board equipment being installed under this contract to the bus ignition switch. <p>Electrical Characteristics.</p> <p>Primary Power: Vehicle Battery 12/24 volts. Battery Life: Mandatory 8 Hours normal operation.</p>

	<p>e. GPS Based VTCU software will be upgradeable/ configurable. ITS vendor support team will help in such firmware upgrade.</p> <p>f. The VTCU within the bus shall be easily accessible for servicing to specified vendor but located to prevent tampering or unauthorized removal. ITS vendor must inform Authority/UPTS for such unlawful activity.</p> <p>Note: JNNURM Buses are already fitted with VTCU. Those buses that are not fitted with VTCU need to be fitted with the same.</p>
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SMS Management for Vehicle Tracking & PIS System:

The system shall cater to the following.

- a) Arranging with a SMS service provider for providing the SMS service with a standard number.
- b) System shall automatically reply (send SMS) to all SMS enquiries.
- c) The rate at which the SMS shall be charged to the end user is to be indicated and should comply with the guidelines from telecom authorities.
- d) Provide reports regarding number of SMS's received (category wise) and sent (category wise), cost of the SMS's and revenue generated for this service.
- e) The system shall have provision to send SMS to concerned mobile numbers (APSRTC Officials) by TSRTC users, on selected criteria, with customized message.
- f) The revenue generated by this service shall accrue to TSRTC and the commercial arrangement proposed for handling SMS shall be clearly provided by the bidder.

3.10.2 PIS Display on Buses

Display Characteristics	
1.	This inbuilt Bus display system will have front display board, rear display board, side display board each
2.	<p>The functionality of In Bus Display System is as follows:</p> <ol style="list-style-type: none"> a. PIS will be used to display information to passengers at each station along the corridor. b. The next arrival bus stop information and the current bus stop information will be displayed inside the bus for the passengers based on the location information collected by bus control unit. This information will be sent from the control unit to display system. c. The display will automatically display the bus stop name and produce audio announcement when the bus reaches a particular stop based on the signal derived from the AVL. d. The display characteristic will be two lines English /one line Telugu language with upto 6 characters, on front, side and rear signs. e. Fixed, scrolling and flashing mode (with fixed route number, upto 6 characters, on front, side and rear signs).

Technical Specifications

S.No	Parameter	Minimum Specification
1	LED Pitch	7.62 mm x 7.62 mm (H x V), DOT Matrix
2	LED's	5mm, High Intensity, Amber Color
3	LED Matrix	128 x 16
4	Brightness	150 mcd
5	Visibility	Clearly visible in Day and Night, in all weathers at a distance up to 20 meters
6	Character Size	1-line 120.4 mm and 2-line 60.2 mm each
7	Visual Effects	Still (fixed), Scrolling and Combination of Still and Scrolling
8	Communication Interface	RS-485, Baud Rate up to 115.2Kbps
9	Voltage	24V DC (18 V to 32V) 1.1 A @ 100% intensity when all LED's ON < 0.5 A @ 100% intensity for normal display < 0.25A @ low intensity for normal display
10	Cabinet	830 mm x 160 mm x 40 mm (L x H x D) Rugged construction with steel and Powder Coated. Vibration proof (confirm to IP66)
11	Operating Temperature	-10°C to 70°C
12	Operating Humidity	5% RH to 98%RH

Viewing Distance:

Front, side and rear signs 50 meters minimum, for single line text, in day and night Inner 15 meters minimum, for single line text in day and night

The detail specification of in bus display system will be as per JnNURM UBS II specification i.e. <http://jnnurm.nic.in/wp-content/uploads/2013/01/Chapter-10-ITS.pdf>

3.10.3 PIS Display at Bus Stations

S. No.	Parameter	Min-Requirement
1	Type of Display, Screen Size	Full Color, LED Display, Day Light Readable Min 50 Inch LED TV
2	Min & max viewing distance and angle of viewing	Viewing distance 20 - 100 meters Minimum 60°V – 110°H
3	Environmental specifications	Temperature: 0 to +55 deg. C; Sealing: IP 65 (Front), IP 54 (Rear) Humidity: 95% RH, Industrial Grade

S. No.	Parameter	Min-Requirement
4	Minimum life of the display system	100,000 hours
5	Power supply	90 V to 250 V AC
6	Display format	Multimedia content, Text in Teulgu, Hindi & English with presentation in tables, Fixed and scrolling Text

3.10.4 Electronic Ticketing Machine

S. No.	Parameter	Min-Requirement
1	Processor	ARM 11 or equivalent and 32-bit RISC with a minimum of 400 MHz processor or equivalent or higher.
2	Operating System	Linux / Windows/ Android (4.2 or above) or equivalent
3	RAM	64 MB
4	Flash Memory	128 MB
5	Extendable Memory	Micro SD Card upto 2 GB
6	Display	3.5 Inch, 320X240 Colour Screen (GUI design has to be user friendly and Fonts used should be easily readable by the Conductor / Inspector)
7	Keypad	Minimum 21 keys
8	Thermal Printer	57mm, 18 lines per second
9	SAM Slots	Min 2 SAM slots (validate E-Purse RFID Cards to connect with other modes)
10	RTC	In built RTC with battery backup
11	GPRS/USSD	Wireless Wide Area GSM/GPRS on dual band (850/900/1800/1900 MHz)
12	Battery	Li-ion/Li-polymer, Min 2100 mAH (Print 800 tickets per shift with a minimum of 12 hours of operations with real time data transfer and smart card read & write facility)
13	Weight	Max. 500 grams
14	Communication Ports	Both USB and RS232
15	Security	Should support encryption standards including 3DES and AES for smart card reading/writing as well as communication with Central System
16	Certification	EMV Level 1 & 2
17	Operating temp.	5 – 55 degree C
18	Voltage	Input: 100~240VAC, 50Hz / 60Hz, 1.0A, Output: 9VDC, 2.5A
19	Contactless Smart Card Reader	Inbuilt Contact-less Smart Card reader: ISO 14443 (Type A & B)
20	Indications on display	Battery charge status; GSM Signal strength
21	Audio	Beeps on key-press and transactions

S. No.	Parameter	Min-Requirement
22	Others	Remote Administration; Over the air upgrade of firmware, application, configuration parameters, master data, etc. should be possible.
23	Accessories	Shoulder carry bag; AC charger (working from 160 V to 250 V) Periodic data transfer from ETM to Data Centre

3.11 Integrated Command and Control Centre – Functional Requirement & Technical Specifications

GWMC has provided the floor plan for ICC. Please refer Annexure. Details of location for Secondary CCC will be provided by the Police HQ to the successful bidder. Bidders are expected to do the site survey of the existing facility and come up with design considerations and capacity considerations for infrastructure for facility management and support services for DC and ICC such as NOC Room, UPS room, War room, Meeting and Manager rooms etc.

Bidders are expected to propose any additional item to complete the solution

#	Functions	Minimum Specifications	Bidder Compliance	Product Documentation Reference
1.	Make		<to be provided by the bidder>	
2.	Model		<to be provided by the bidder>	
3.	Solution & Platform	The Command & Control solution should be implemented and complied to the industry open standards based Commercial-of-the-shelf (COTS) products.		
4.		Must have built-in fault tolerance, load balancing and high availability & must be certified by the OEM.		
5.		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.		
6.		System must provide a comprehensive API (Application Program Interface) or SDK (Software Development's Kit) to allow interfacing and integration with existing systems, and future application and sensors which will be deployed on the field. OEM should submit their datasheet , ordering guide and API document available on public domain		
7.		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 make it easy to exchange data and services between them.		
8.		The system shall allow seamless integration with all of the department's existing and future initiatives (as mentioned in 6.1.5)		

9.		The platform should be able to integrate with any type of sensor platform being used for the urban services irrespective of the technology used.		
10.		The platform should be able to normalize the data coming from different devices of same type (i.e. Different lighting sensor from different OEMs, different energy meters from different OEMs etc.) and provide secure access to that data using data API(s) to application developers		
11.	Convergence of Multiple feeds / services	System need to have provision that integrates various services and be able to monitor them and operate them. The solution should provide option to integrate existing deployed solution by City and also need to provide scalability option to implement new use cases. System should support DDE and OLE for integration with Process control systems and sensors System should have capability to source data from various systems implemented in Warangal City to create actionable intelligence		
12.		The ICCC platform comprising pre-integrated visualisation layer and IoT platform proposed should be deployed in atleast 1 city in India 5 cities globally with multiple smart city use cases		
13.	Industry Standards for the Command & Control Center	The solution should adhere to the Industry standards for interoperability, data representation & exchange, aggregation, virtualization and flexibility OEM should have registered office in India and should have software development center in India.		
14.		IT Infrastructure Library (ITIL) standards for Standard Operations Plan & Resource Management		
15.		Geo Spatial Standards like GML & KML etc.		
16.		Business Process Model and Notation (BPMN) or equivalent for KPI Monitoring.		
17.	Command & Control Center Components	<ul style="list-style-type: none"> Web server to manage client requests. 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 preconfigured views in common formats. All information to be displayed through easy-to-use dashboards. 		

18.	<ul style="list-style-type: none"> • 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 the contacts and instant messaging service to enable effective, real-time communication. It should provide business monitoring service to monitor incoming data records to generate key performance indicators. It should also provide the 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. • System Platform – The platform should provide a common data integration layer which can collect and contextualize information from disparate data sources regardless of protocol. The platform should support templatization to allow “build once-deploy everywhere” functionality. • Workflow and Incidents Lifecycle engine – This function should allow users to define and modify new workflows. The workflow could cut across multiple systems via the interfacing modules. Workflow for operational alerts and escalations should be triggered automatically without human intervention. Workflow approvals should have facility to approve from any device with e-signature. This function should provide facility to trigger a corrective action workflow and define the stakeholders for the same. Should manage the life cycle of incidents and related entities via pre-define workflows. The workflow could cut across multiple systems via the interfacing modules. Workflow for operational alerts and escalations should be triggered automatically without human intervention. • Incidents Planning – should manage the planning preparations of an incident including resource allocation, tasks management etc. • Analytics and MIS – should provide users with business analytics reporting and tools to organize, evaluate and efficiently perform day to day operations • Analytics and MIS - should provide users with a self-service platform for business reports predictive , prescriptive 		
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		<p>analytic tools to organise , evaluate and efficiently perform day to day operations. The predictive models should be self-learning models .Analytics solutions should be able to provide prescriptive analytics for single and cross domain with key focus on smart city domain viz. parking light, environment, waste, urban resilience, E-Governance ..etc. Analytics Solution should be able to make predictions that can help in automation of operational policies of ICCC and with a prediction accuracy of atleast 70%</p> <ul style="list-style-type: none"> • Security & Roles – should manage roles definition for internal as well as external access • Centralized data archiving for operational data : Should provide facility for centralized storage of operational data (time-series or transactional) with high granularity and data compression capability • Mobility: should enable app-based access to monitor alerts, KPI , KOPs, SOPs and reports to mobile users. Should support popularly user’s smartphone /tablets. App content should be presented in context to the user role. 		
19.	Incident Management	The system must provide Incident Management Services to facilitate the management of response and recovery operations:		
20.	Requirements	Should support comprehensive reporting on event status in real time manually or automatically by a sensor/CCTV video feeds.		
21.		Should support for sudden critical events and linkage to standard operating procedures automatically without human intervention.		
22.		Should support for multiple incidents with both segregated and/or overlapping management and response teams.		
23.		Should support Geospatial rendering of event and incident information.		
24.		Should support plotting of area of impact using polynomial lines to divide the area into multiple zones on the GIS maps.		
25.		Should support incorporation of resource database for mobilizing the resources for response.		
26.		Should provide 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.		

27.		The system must identify and track status of critical infrastructure / resources and provide a status overview of facilities and systems		
28.		Should provide detailed reports and summary views to multiple users based on their roles.		
29.		A Reference Section in the tool must be provided for posting, updating and disseminating plans, procedures, checklists and other related information.		
30.		Provide User-defined forms as well as Standard Incident Command Forms for incident management.		
31.	Integrated User Specific &	Should provide integrated dashboard with an easy to navigate user interface for managing profiles, groups, message templates, communications, tracking receipts and compliance		
32.	Customizable Dashboard	<ul style="list-style-type: none"> Collects major information from other integrated City sensors/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 		
33.		Should provide tools to assemble personalized dashboard views of information pertinent to incidents, emergencies & operations of command center		
34.		Should provide historical reports, event data & activity log. The reports can be exported to pdf or html formats.		
35.		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		
36.	Integration with Social Media & Open Source Intelligence	Should provide integration of the Incident Management application with the social media. Should Provide analytics based on the social media feed collected from the open source intelligence and collate with the surveillance inputs to alert the responders for immediate action on the ground.		
37.		Should extract messages and display it in an operational dashboard.		
38.		Should be able to correlate the extracted message from the social media with existing other events and then should be able to initiate an SOP.		

39.		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.		
40.		Should provide notifications to multiple agencies and departments (on mobile) that a new intelligence has been gathered through open source/social media.		
41.	Device Status, Obstruction	Should provide icon based user interface on the GIS map to report non-functional device.		
42.	Detection and Availability	Should also provide a single tabular view to list all devices along with their availability status in real time.		
43.	Notification	Should provide User Interface to publish messages to multiple devices at the same time.		
44.	Event Correlation	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.		
45.	Standard Operations Procedures (SOP)	Command & Control Center should provide for authoring and invoking un-limited number of configurable and customizable standard operating procedures through graphical, easy to use tooling interface.		
46.		Standard Operating Procedures should be established, approved sets of actions considered to be the best practices for responding to a situation or carrying out an operation.		
47.		The users should be able to edit the SOP, including adding, editing, or deleting the activities.		
48.		The users should be able to also add comments to or stop the SOP (prior to completion).		
49.		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.		
50.		The SOP Tool should have capability to define the following activity types:		
51.		Manual Activity - An activity that is done manually by the owner and provide details in the description field.		
52.		Automation Activity - An activity that initiates and tracks a particular work order and select a predefined work order from the list.		

53.		If-Then-Else Activity - A conditional activity that allows branching based on specific criteria. Either enter or select values for Then and Else.		
54.		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.		
55.		SOP Activity - An activity that launches another standard operating procedure.		
56.	Key Performance Indicator	Command & Control Center should be able to facilitate measurement or criteria to assay the condition or performance of departmental processes & policies.		
57.		Green indicates that the status is acceptable, based on the parameters for that KPI, no action is required.		
58.		Yellow indicates that caution or monitoring is required, action may be required.		
59.		Red indicates that the status is critical and action is recommended.		
60.	Reporting Requirements	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		
61.		The solution should generate Customized reports based on the area, sensor type or periodic or any other customer reports as per choice of the administrators		
62.	Collaboration Tools	Should provide tools for users to collaborate & communicate in real-time using instant messaging features.		
63.	Communication	The solution should adhere to the below mentioned communication requirements.		
64.	Requirements	Provide the ability to search/locate resources based on name, department, role, geography, skill etc. for rapidly assembling a team, across department, divisions and agency boundaries, during emergency		
65.		Provide the capability to Invite - Using information provided during the location of those individuals or roles, invite them to collaborate and to share valuable information.		
66.		Provide a single web based dashboard to send notifications to target audiences using multiple communication methods including voice-based notification on PSTN/Cellular, SMS, Voice mail, E- mail and Social Media		

67.		The solution should provide Dispatch Console integrates with various communication channels. It should provide rich media support for incidents, giving dispatchers the power to consolidate information relating to an incident and instantly share that information among responder teams. It should assess the common operating picture, identify & dispatch mobile resources available nearby the incident location. Augment resources from multiple agencies for coordinated response.		
68.	Authentication	Use authentication information to authenticate individuals and/or assign roles.		
69.	Instant messaging	Provide ability to converse virtually through the exchange of text, audio, and/or video based information in real time with one or more individuals within the emergency management community.		
70.	Events and Directives control	Should provide the capability for the events that are produced from a sub- system and are forwarded to the Command & Control Center. Events could be a single system occurrence or complex events that are correlated from multiple systems. Events could be ad hoc, real-time, or predicted and could range in severity from informational to critical. At the Command & Control Center, the event should be displayed on an operations dashboard and analysed to determine a proper directive.		
71.		Directives issued by the Command & Control Center should depend on the severity of the monitored event. Directives will be designed and modified based on standard operating procedures, as well as state legislation. A directive could be issued automatically via rules, or it could be created by the operations team manually.		
72.	What-if Analysis Tool	The solution should provide the capability to manage the emergencies and in-turn reducing risks, salvaging resources to minimize damages and recovering the assets that can speed up recovery.		
73.		To take proactive decisions that help minimize risks and damages, the solution should provide Analytical and Simulation systems as part of the Decision Support System. The solution should help simulate what if scenarios. It should help visualize assets/resources at risk due to the pending/ongoing incident, should render impacted region on a GIS/3D map. The solution should help build the list of assets, their properties, location and their interdependence through an easy to use Graphical User Interface. When in What if Analysis mode the solution should		

		highlight not only the primary asset impacted but also highlight the linked assets which will be impacted. The user should be able to run the What-if Analysis mode for multiple types of emergency events such as Bomb Blast, Weather events, Accidents etc.		
74.	Resource & Route Optimization	The system should provide the software component for the message broadcast and notification solution that allows authorized personal and/or business processes to send large number of messages to target audience (select-call or global or activation of pre-programmed list) using multiple communication methods including SMS, Voice (PSTN/Cellular), Email and Social Media.		
75.	Alert & Mass Notification Requirements	Provide a single web based dashboard to send notifications to target audiences using multiple communication methods including voice-based notification on PSTN/Cellular, SMS, Pager, Voice mail, E-mail and Social Media		
76.		Provide function for creating the alert content and disseminating to end users. Provision of alerting external broadcasting organizations like Radio, TV, Cellular, etc., as web-service.		
77.		Provide Role based security model with Single-Sign-On to allow only authorized users to access and administer the alert and notification system.		
78.	Security & Access Control	Provide comprehensive protection of web content and applications on back-end application servers, by performing authentication, credential creation and authorization.		
79.	Internet Security	Comprehensive policy-based security administration to provide all users specific access based on user's responsibilities. Maintenance of authorization policy in a central repository for administration purposes.		
80.	Authorization	Should support to enable assignment of permissions to groups, and administration of access control across multiple applications and resources. Secure, web-based administration tools to manage users, groups, permissions and policies remotely		
81.	User group	Provide policies using separate dimensions of authorization criteria like Traditional static Access Control Lists that describe the principals (users and groups) access to resource and the permissions each of these principals possess.		
82.	Provide multi-dimensional access control	SSO to Web-based applications that can span multiple sites or domains with a range of SSO options.		

83.	Flexible single sign-on (SSO)	Support LDAP authentication mechanism		
84.	Authentication	Should have ability to respond to real-time data with intelligent & automated decisions		
85.	Rule Engine & Optimization	Should provide an environment for designing, developing, and deploying business rule applications and event applications.		
86.		The ability to deal with change in operational systems is directly related to the decisions that operators are able to make		
87.		Should have at-least two complementary decision management strategies: business rules and event rules.		
88.	Situational Awareness COP (Common Operational Picture)	<ul style="list-style-type: none"> • The CCA should be able to combine data from various sources and present it as different views tailored to different operator's needs. • The CCA should automatically update the information based on alarms and incidents that are presented to it via the business rules engine. The polling and CCA 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"> ○ Tasks assignment and their status ○ Agencies involved ○ Resources deployed ○ Incident status across relevant parameters of the incident e.g. household affected by a transformer shut down ○ Timeline view of the situation ○ Suggested actions from the system with their status 		
89.	Task Management	<ul style="list-style-type: none"> • The system should be able to create, assign, track and report on the lifecycle of tasks during a particular incident. • The system should allow a particular task to be decomposed into sub-tasks. • The system should provide an easy to interpret management dashboard view of the progress of all tasks during an incident. • The system should be able to organise the visual representation of tasks into prioritized list, filtered list, as 		

		<p>well as colour coded representation for ease of understanding.</p> <ul style="list-style-type: none"> • The system should be able to perform the following functions around task management: <ul style="list-style-type: none"> ○ Create a task with unique ID. (Subtasks shall follow parent ID with second level numbering). ○ Assign a target completion date and time for the task, either directly or as a time-span from the task’s creation. ○ Date and time stamp of the creation of the task. ○ Log and track status of tasks. System should provide capability to define status of tasks during its lifecycle. These status definitions could be mapped to other task attributes such as the task type. ○ Key-word search against task list. • The above attributes shall be colour coded. • The system shall allow the tasks to be filtered on the real-time dashboard by agency then by task status. This filtering should allow an operator to filter for all tasks of a particular state or a combination of state; and by the time remaining until (or time elapsed since) the target completion time. • The system should allow multiple individual workstations to select specific agencies of interest on each workstation simultaneously. • The system should allow the GWSCCL to display all agencies’ tasks simultaneously as well. • The tasks should be displayed on a real-time timeline. • The criticality of tasks should be dynamically changed depending on the performance of the incident response. 		
90.	Timeline and Charting	<ul style="list-style-type: none"> • The system should provide a facility to see incidents and actions (tasks) added to the CCA in a tabular list form as well as Gantt chart format filtered by day, week, month, year or any specific date range. • The system should provide a facility to see incidents, actions and interdependencies between actions in a clear visual graphical manner. • The system should be able to filter the information based on at least the following parameters: <ul style="list-style-type: none"> ○ Incident information ○ Resources information ○ Agency type 		

		<ul style="list-style-type: none"> ○ Tasks ○ Criticality or priority 		
91.	GIS Display	<ul style="list-style-type: none"> ● Shall view the environment through geospatial or fixed composite computer-generated (JPEG, BMP, AutoCAD, etc.) map ● Should allow user to view sensor and related name from the displayed map ● Should allow all resources, objects, sensors and elements on the map to be geo-referenced such that they have a real world coordinate. ● Should visually display a camera sensor with related camera orientation, camera range and camera field of view angle. ● Should visually display an alarming sensor on map ● Should visually differentiate sensor alarm severities on map through different color and icon identifiers ● Should immediately view alarm details (including description, video, etc.) and investigate the alarm from the map ● Should allow user to choose camera and other sensors from map to view live video and the data ● Should allow user to choose camera and take live video image snapshot and save to file from any camera ● Should allow user to choose camera from map to move PTZ cameras ● Should allow user to choose camera to play, pause, stop, fast-forward, rewind, and play recorded video from preset time ● Should allow user to choose camera and take recorded video image snapshot and save to file or print from any live or recorded video ● Should allow user to jump from one map to the next with a single click of a mouse with map links ● Should allow map information “layers” to be displayed/hidden on items such as – <ul style="list-style-type: none"> ○ Sensor names ○ Sensors ○ Sensor range (e.g. camera – orientation, range, field of view angle) <ul style="list-style-type: none"> ▪ Locations and zones ▪ Perimeter ranges 		

		<ul style="list-style-type: none"> ▪ Resource tracks ▪ Allow user to zoom in/out on different regions of map graphic 		
92.	Video Display	<ul style="list-style-type: none"> • Shall view live or recorded video from resizable and movable windows • Should have an ability to perform video controls for video systems from workstation • Shall play, fast-forward, rewind, pause, and specify time to play recorded video • Shall take a video still image (snapshot) from live or recorded video • Shall export video for user specified time and duration • Shall have the capability to move PTZ cameras • Shall view Video in Video Matrix • Shall display in 1x1, 2x2, 3x3 and 4x4 window formats • Shall enable operator to specify video windows to be displayed in matrix • Shall enable matrix settings to be saved per user • Shall view either live or recorded video can be displayed in the video matrix window. • Shall enable video snapshot to be taken and saved from any window pane in the matrix view • Shall rotate video in “virtual” video guard tour • Shall rotate through multiple video views based on predefined video camera sequence and duration. • Shall enable the user to pause the rotation of video and resume the video rotation again • Shall enable times between new video to be adjusted • Shall enable both live video and recorded video to be played through the video guard tour. • Shall enable alarms to be generated from any video pane • Shall enable user to only view and control video for which they have been assigned permissions by the administrator • Shall manually create an alarm from the live or recorded video with specified severity and description 		
93.	Alarm Display	<ul style="list-style-type: none"> • Should have an ability to display alarm condition through visual display and audible tone • Should have an ability to simultaneously handle multiple alarms from multiple workstations 		

		<ul style="list-style-type: none"> • Should have an ability to automatically prioritize and display multiple alarms and status conditions according to pre-defined parameters such as alarm type, location, sensor, severity, etc. • Should display the highest priority alarm and associated data / video in the queue as default, regardless of the arrival sequence 		
94.	Historical Alarm Handling	<ul style="list-style-type: none"> • Should have an ability to view historical alarms details even after the alarm has been acknowledged or closed. • Should have an ability to sort alarms according to date/time, severity, type, and sensor ID or location. 		
95.	Alarm Reporting	<ul style="list-style-type: none"> • Should have an ability to generate a full incident report of the alarm being generated. • Should have an ability to display report on monitor and print report • Should have details of alarm including • severity, time/date, description and location • Captured video image snapshots • Relevant sensor data such as SCADA sensors • Response instructions • Alarm activities (audit trail) • Should have an ability to export alarm report in various formats including pdf, jpeg, html, txt, and mht formats • Should have an ability to generate an alarm incident package including the full incident report and exported sensor data from the incident in a specific folder location. 		
96.	Alarm Policies and Business Logic Administration	<ul style="list-style-type: none"> • The CCA solution should have the following ability to handle the workflow alarms through graphical user interface. • Should have an ability to match keywords or text from the alarming subsystem's incident description to raise an alarm using criteria including exact match, exact NOT match, contains match, wildcard match and regularly expression match (such as forced door alarm, denied access, door open too long, etc.) • Should have an ability to optionally match alarming subsystem's incident status, incident severity, and sensor type • Should have an ability to apply any alarm policy to one or more monitoring area(s) or zone(s) without having to reapplying the policy multiple times. 		

	<ul style="list-style-type: none"> • Should have an ability to apply any alarm policy to one or more sensors without having to reapply the policy multiple times. • Should have an ability to assign specific actions for each alarm • Should have an ability to activate or deactivate alarms as required • Should have an ability to create exceptions • Should Create batch-wise rules and process them • Should Check and rectify logical errors and contradictory rules • Should have an ability to schedule execution of rules • Should Suspend or Terminate the application of rule • Should archive unused or deactivated rules 		
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3.11.1 Contact Centre at GWMC premise and CP HQ:

#	Minimum Requirements	Bidder Compliance(Yes /No)	Product Documentation Reference
1	Make	<to be provided by the bidder>	
2	Model	<to be provided by the bidder>	
3	For upto 10 agents		
4	Automatic call distribution		
5	Automatic identification of incoming number based on landline and mobile number mapping		
6	Call recording mapped to incident tickets		
7	Customizable agent and supervisor desktop layout		
8	Inbound and outbound capability		
9	Call control		
10	Multisession web chat		
11	Email		
12	Live data reporting gadgets		

13	Phonebook		
14	Multiline support		
15	Speed dial in IP phones		

Note: Bidder to provide similar infrastructure at CP HQ CCC and GWMC CCC

3.11.2 IP Push to Talk (interpretability Communication Channel)

#	Minimum Requirements	Bidder Compliance(Yes/No)	Product Documentation Reference
1	Make	<to be provided by the bidder>	
2	Model	<to be provided by the bidder>	
3	IP Push to Talk Radio: Instant communication to critical first responders via push to talk over IP. This will enable All communication across various business sites.		
4	The radio over IP solution must integrate any analog or digital radio system, any to any Push To Talk (PTTT) communications.		
5	The system shall create virtual talk groups (VTGs) to facilitate Push-to-Talk (PTT) communications between users of multiple types and technologies of Land Mobile Radios with users of PCs, landline phones, cellular and android phones, and IP phones.		
6	The system shall provide a High Availability option of adding a secondary hot standby server to provide high availability with no single point of failure. If a primary server fails, the secondary server automatically takes over service without communication interruption		
7	The solution must send encrypted data for PTT communications.		
8	The system shall provide a web service API to integrate System with third party applications, such as Command and Control		
9	The system shall support role-based management to provide compartmentalized functions for personnel who need to perform different roles.		
10	System should be capable to the system shall provide an easy-to-use Web interface. Authorized personnel shall be able to access the System Server from any location by using a supported browser and a network connection		

11	Integrate with IP phones to talk to radio walkie talkies / Any other compatible Phone		
12	The system shall provide Loop Prevention: As multiple dispatchers patch channels together, there is always the possibility of creating a channel loop that causes audio feedback into the communication path. The system should automatically identify potential audio loops and resolve them before they become an issue		
13	The System Server shall provide an audit trail for analysis, critique, and operations management. Detailed activity logging shall allow administrators to determine which user actions were performed and when they were performed		

Note: Bidder to provide similar infrastructure at CP HQ and GMWC CCC

3.11.3 Video Wall Screen

#	Parameter	Minimum Specifications	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make	<to be provided by the bidder>		
2.	Model	<to be provided by the bidder>		
3.	Configuration	Seamless Video wall of DLP Cubes. Each cube size to be 55" or more with complete configuration of (3 cubes x 2 cubes) with covered base. All cubes have to be of the exactly same size, configuration and model wise mandatorily. The wall to be installed in curved fashion with all required support system like Controller / stand for DLP Cubes / Interfaces / Connecting cables. Bidder may also propose suiting local conditions		
4.	Operation	24 X 7 : The Video Walls & Controllers and all support systems should be capable of working in 24 x 7 mode without any deterioration in the performance		
5.	Chip Type	1-chip 0.95" Digital Micro Mirror Device		
6.	Resolution	1920 x 1200 native (WUXGA Display)		
7.	Light Source Type	LED light source with separate LED array for each colour (RGB)		
8.	Brightness ANSI	Minimum 700 Lumens		
9.	Brightness Uniformity	≥ 90 %		
10.	Dynamic Contrast	1400000:1 or more		

11.	Redundant Dual Power Supply	Cube should be equipped with a built in dual redundant power supply		
12.	Hot Swappable Power Supply	The inbuilt power supply should be hot swappable		
13.	Control	IP based control to be provided		
14.	Remote	IR remote control should also be provided for quick access		
15.	Screen to Screen Gap	≤ 0.3 mm		
16.	Screen Support	Screen should have an anti-reflective glass backing to prevent bulging		
17.	Cooling Inside Cube	By Means of a heat pipe. No liquid cooling.		
18.	Cube Depth	740mm or less		
19.	Maintenance Access	Rear		
20.	Inputs in the Cube	DVI-2, HDMI-1, HDbaseT-1, Display port-1		
21.	Output in Cube	DVI – 1		
22.	Cube control & Monitoring	Video wall should have cube control & monitoring system which can provide video wall status including source, light source, temperature, fan & power information. The system should be based on web-browser architecture. Should be able to provide an error message in three sections: a) Problem area b) Error Module Location c) Error Module Image		

3.11.4 Video Wall Controller

#	Parameter	Minimum Specifications	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make	<to be provided by the bidder>		
2.	Model	<to be provided by the bidder>		
3.	Display controller	Controller to control Video Walls in a matrix of 5 x 2 with 16 DVI outputs (for future expansion) , 4 Universal inputs & DUAL LAN INPUTS along with necessary software's		
4.	Processor	Single Quad Core Intel® Xeon/i7 64-bit 2.0 GHz CPU or better		
5.	RAM	8GB		
6.	HDD	500 GB Hard Disk		
		Hard disk Capacity should be upgradable		
7.	RAID	* RAID 0 configured with usable space of 500 GB in each controller		
8.	Networking	* Dual-port Gigabit Ethernet Controller inbuilt		
		* Support for Add on Network adapters		
		* Support for Optical Fiber interface Adapters		
9.	Accessories	DVD-R,DVD+RW,, Keyboard, mouse		
10.	OS	* Supports 64-bit Operating Systems Windows 7		
11.	Power Supply	(1 + 1) Redundant AC-DC high-efficiency power supply w/ PFC		
		* AC Voltage 100 - 240V, 50-60Hz		
	Chassis	* 19" industrial Rack mount movable		

12.		Front Panel should have lockable Door to Protect Drives		
13.	System Reliability	* Operating Temperature range : 10° to 35°C (50° to 95°F)		
		* Non-operating Temperature range : -40° to 70°C (-40° to 158°F)		
		* Operating Relative Humidity range : 8% to 90% (non-condensing)		
		* Humidity: 10 – 90% non-condensing		
		* Non-operating Relative Humidity: 5 to 95% (non-condensing)		
14.	Wall configuration	16 DVI-D Outputs		
15.	Resolution	1920x1200 per output minimum (WUXGA)		
16.	Universal Inputs	8 Universal Inputs (Should be able to accept at least 4 kinds of signals i.e. DVI/RGB/Component Video) along with USB 3.0		
17.	Redundancy Support	System Should have the redundancy support for Controller HDD, power supply & LAN (Gigabit Ethernet RJ-45 connection)		
18.	Connectivity	Connectivity between the controller & Video wall should be on Optical Fiber cables only.		
19.	Video Wall, Controller, Cube & wall management	Video Wall, Controller, Cube & Wall management software should be from same OEM for ensuring smooth operations and seamless integration and feature enablement and enhancement. All licenses of the software supplied with Controller and Video Wall should be with perpetual license and cost of the same should be included in the quoted cost.		
20.	Controller configuration	Two controllers should be provided which can act as backup to each other i.e. a single controller should be able to drive all the cubes of both the video walls.		

21.	Video Wall stand	Video Wall should be mounted on stand with minimum height of 750 mm (two and half feet) with flexibility of 50 mm height		
22.	Warranty	Comprehensive onsite warranty on the DLP video wall and Controller for 5 years		

3.11.5 Video Wall Management Software

#	Parameter	Minimum Specifications	Bidder Compliance (Yes/No)	Product Documentation Reference
1	Make		<to be provided by the bidder>	
2	Model		<to be provided by the bidder>	
3	Display & Scaling	Display multiple sources anywhere on display up to any size		
4	Input Management	All input sources can be displayed on the video wall in freely resizable and movable windows		
5	Scenarios management	Save and Load desktop layouts from Local or remote machines		
6	Layout Management	Support all Layout from Input Sources, Internet Explorer, Desktop and Remote Desktop Application		
7	Multi View Option	Multiple view of portions or regions of Desktop, Multiple Application Can view from single desktop		
8	Other features	SMTP support		
9		Remote Control over LAN		
10		Alarm management		
11		Remote management		
12		Multiple concurrent client		
13		KVM support		

14	Cube Management	Cube Health Monitoring		
15		Pop-Up Alert Service		
16		Graphical User Interface		

3.11.6 Monitoring Workstations

#	Parameter	Minimum Specifications	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make		<to be provided by the bidder>	
2.	Model		<to be provided by the bidder>	
3.	Processor	Latest generation 64bit X86 Quad core processor(3Ghz) or better		
4.	Chipset	Latest series 64bit Chipset		
5.	Motherboard	OEM Motherboard		
6.	RAM	Minimum 8 GB DDR3 ECC Memory @ 1600 Mhz. Slots should be free for future upgrade. Minimum 4 DIMM slots, supporting up to 32GB ECC		
7.	Graphics card	Minimum Graphics card with 2 GB video memory (non- shared)		
8.	HDD	1 TB SATA-3 Hard drive @7200 rpm with Flash Cache of 64GB SSD		
9.	Media Drive	NO CD / DVD Drive		
10.	Network interface	10/100/1000 Mbps autosensing on board integrated RJ-45 Ethernet port.		

11.	Audio	Line/Mic IN, Line-out/Spr Out (3.5 mm)		
12.	Ports	Minimum 6 USB ports (out of that 2 in front)		
13.	Keyboard	104 keys minimum OEM keyboard		
14.	Mouse	2 button optical scroll mouse (USB)		
15.	PTZ joystick controller (with 2 of the workstations in SCOC)	<ul style="list-style-type: none"> • PTZ speed dome control for IP cameras • Minimum 10 programmable buttons • Multi-camera operations • Compatible with all the camera models offered in the solution • Compatible with VMS /Monitoring software offered 		
16.	Monitor	Three Monitors of 22" TFT LED monitor, Minimum 1920 x 1080 resolution, 5 ms or better response time, TCO 05 (or higher) certified. The TFT Monitor, CPU, Mouse and keyboard workstation shall be of same make.		
17.	Certification	Energy star 5.0/BEE star certified		
18.	Operating System	64 bit pre-loaded OS with recovery disc		

19.	Security	BIOS controlled electro-mechanical internal chassis lock for the system.		
20.	Antivirus feature	Advanced antivirus, antispymware, desktop firewall, intrusion prevention (comprising of a single, deployable agent) which can be managed by a central server. (Support, updates, patches and errata for the entire contract/ project period)		
21.	Power supply	SMPS; Minimum 400-watt Continuous Power Supply with Full ranging input and APFC. Power supply should be 90% efficient with EPEAT Gold certification for the system.		

3.11.7 LED Display

#	Parameter	Minimum Specifications	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make	<to be provided by the bidder>		
2.	Model	<to be provided by the bidder>		
3.	Technology	HD LED Display , Direct LED Backlight		
4.	Screen Size	55 inch diagonal or better for viewing centers		

5.	Resolution	Full high definition (Min 1920 x 1080) 16:9 Widescreen		
6.	Contrast ratio	5000:1		
7.	Brightness	350 nit		
8.	Viewing angle	178 degree/178 degree (H/V)		
9.	Response time	8ms		
10.	Control	- RS232 control - On Screen Display (OSD) - IR remote control		
11.	Operations	24x7		
12.	Additional Specifications	Should be at least UL / FCC, BIS, BEE/Energy Star certified		

3.11.8 IP Phones

#	Parameter	Minimum Specifications	Bidder Compliance (Yes/No)	Product Documentation Reference
1	Make		<to be provided by the bidder>	
2	Model		<to be provided by the bidder>	
3	Display	2 line or more, Monochrome display for viewing features like messages, directory		
4	Integral switch	10/100 mbps for a direct connection to a 10/100BASE-T Ethernet network through an RJ-45 interface		
5	Speaker Phone	Yes		
6	Headset	Wired, Cushion Padded Dual Ear-Speaker, Noise Cancelling headset with mouthpiece microphone, port compatibility with IP Phone		

7	VoIP Protocol	SIP V2		
8	POE	IEEE 802.3af or better and AC Power Adapter (Option)		
9	Supported Protocols	SNMP, DHCP, DNS		
10	Codecs	G.711, G.722, G.729 including handset and speakerphone		
11	Speaker Phone	Full duplex speaker phone with echo cancellation Speaker on/off button, microphone mute		
12	Volume control	Easy decibel level adjustment for speaker phone, handset and ringer		
13	Phonebook/Address book	Minimum 100 contacts		
14	Call Logs	Access to missed, received, and placed calls. (Minimum 20 overall)		
15	Clock	Time and Date on display		
16	Ringer	Selectable Ringer tone		
17	Directory Access	LDAP standard directory		
18	QoS	QoS mechanism through 802.1p/q		

3.11.9 Network Color Laser Printer

#	Parameter	Minimum Specifications	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make		<to be provided by the bidder>	
2.	Model		<to be provided by the bidder>	

3.	Print Speed	Black : 16 ppm or above on A3, 24 ppm or above on A4 Color : 8 ppm or above on A3, 12 ppm or above on A4		
4.	Resolution	600 X 600 DPI		
5.	Memory	8 MB or more		
6.	Paper Size	A3, A4, Legal, Letter, Executive, custom sizes		
7.	Paper Capacity	250 sheets or above on standard input tray, 100 Sheet or above on Output Tray		
8.	Duty Cycle	25,000 sheets or better per month		
9.	OS Support	Linux, Windows 2000, Vista, 7, 8, 8.1		
10.	Interface	Ethernet Interface		

3.11.10 IP PBX (Call Control Center)

#	Minimum Specifications	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make	<to be provided by the bidder>	
2.	Model	<to be provided by the bidder>	
3.	The IP telephony system should be a converged communication System with ability to run analog and IP on the same platform using same software load based on server and Gateway architecture		
4.	The single IP PBX system should be scalable to support up to 500 stations (any mix/percentage of Analog/IP) to achieve the future capacity		
5.	The system should be based on server gateway architecture with external server running on Linux OS. No card based processor systems should be quoted		

6.	The voice network architecture and call control functionality should be based on SIP		
7.	The call control system should be fully redundant solution with no single point of failure & should provide 1:1 redundancy.		
8.	The communication server and gateway should support IP V6 from day one so as to be future proof		
9.	The entire solution (IP PBX, its hardware, IP Phones, Voice Gateway) should be from a single OEM		
	Support for call-processing and call-control		
10.	Should support signaling standards/Protocols – SIP, MGCP, H.323, Q.Sig		
11.	Voice Codec support - G.711, G.729, G.729ab, g.722, ILBC		
12.	The System should have GUI support web based management console		
	Security		
13.	The protection of signaling connections over IP by means of authentication, Integrity and encryption should be carried out using TLS		
14.	System should support MLPP feature		
15.	Proposed system should support SRTP for media encryption and signaling encryption by TLS		
16.	Secure HTTP support for Call Server Administration, Serviceability, User Pages, and Call Detail Record Analysis and Reporting Tool. Should support Secure Sockets Layer (SSL) for directory		
17.	The administrator logging on to the call control server needs to authenticate by suitable mechanism such as User Login Information and Passwords/ Radius Server		
18.	Voice gateway to be provided with 1 PRI card scalable to 3 PRI in future for PSTN (PRI) line termination.		

3.11.11 Contact Centre Specifications

A. Automatic Call Distribution (ACD):

- 1) 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.
- 2) Should support skill based routing and it should be possible to put all the agents in to a single skill group and different skill groups
- 3) 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.
- 4) ACD should support call routing based on longest available agent, circular agent selection algorithms.
- 5) 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.
- 6) Agents should be able to chat with other Agents or supervisor from the Agent desktop software
- 7) Supervisor should be able to see the real-time status of agents, supervisors should be able to make agent ready or logout from the supervisor desktop
- 8) Should support Queuing of calls and playing different prompts depending on the type of call and time in the queue.
- 9) 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.

B. Interactive Voice Response (IVR):

- 1) IVR should play welcome messages to callers Prompts to press and collect DTMF digits
- 2) IVR should be able to integrate with backend database for self-service, as and when required.
- 3) GUI based tool to be provided for designing the IVR and ACD call flow.
- 4) IVR should support Voice XML for ASR, TTS, and DTMF call flows
- 5) IVR should be able to Read data from HTTP and XML Pages
- 6) IVR should be able to run outbound campaigns.

C. Reporting:

- 1) System to provide report of IVR Application Performance Analysis, Call by Call details for all the calls, Traffic analysis reports etc.

- 2) Reporting platform to support Agent level reports, Agent login, logout report, report on agent state changes
- 3) Queue reports, Abandon call reports all the reports should be summary, tabular and detailed report format to be available for the agents.
- 4) Reporting platform to support custom reports using a combination of the Crystal Reports Developer's Toolkit and SQL stored procedures.
- 5) Users of the Historical Reports should be able to perform the following functions View, print, and save reports. Sort and filter reports, Send scheduled reports to a file or to a printer. Export reports in a variety of formats, including PDF, RTF, XML, and CSV.

D. E-mail:

- 1) Administrator should be able to assign one or more email addresses to a single Queue.
- 2) Email routing support integration with Microsoft Exchange 2003 or Microsoft Exchange 2007 or 2010.
- 3) Agents should be able to automatically resume of e-mail processing on voice disconnect.
- 4) Agent should be able to save email draft response and resume at a later time.
- 5) Agent should be able to re-queue email.
- 6) Supervisor should be able to access real-time reporting for Agent E-Mail mail volume by Queue

3.11.12 Video Conferencing Unit

- 1) Video Standards: H.263, H.264
- 2) Should support 30 fps & 60fps (frames per second) with 1080p resolution from day one
- 3) Video Features: Ability to send and receive two live simultaneous video sources in a single call, so that the image from the main camera and PC or document camera can be seen simultaneously
- 4) Should support H.239 and BFCP protocols with 1080p resolution
- 5) Video Output: Should have at least 2 HDMI / DVI (High Definition Multimedia Interface) output to connect Full High Definition display devices such as LCD / LED and projectors for both Video and Content. (Dual Monitor Support)
- 6) It should be possible to display the main video on one HD screen and the presentation / dual video on the other HD screen.
- 7) Video Input: Should have at least one HD video Input to connect HD camera with full functionalities as mentioned in the camera specifications.
- 8) Should have DVI (Digital Video Interface) input to connect PC / Laptop directly to the Video conferencing system and display resolutions WXGA / HD720p along with PC Audio.

- 9) Audio standards: G.711, G.722, G.722.1, 64 kbps MPEG-4 AAC-LD or equivalent standards must be supported.
- 10) Audio Inputs: Should support minimum 2 Microphone inputs. 1 needs to be supplied from day one.
- 11) 1 LAN / Ethernet - 10/100/1000 Mbps
- 12) IP - at least 6 Mbps bandwidth support
- 13) Security: Password protected system menu
- 14) ITU-T standards based Encryption of the video call
- 15) Camera: Minimum of 12X Optical zoom
- 16) 1920 x 1080 pixels progressive @ 30fps
- 17) Should have at least 70 degrees field of view (horizontal)
- 18) The Camera and codec should be from the same manufacturer

3.11.13 Multiparty Conference Unit (Video and Audio Conferencing Bridge with Secure VC over Internet)

- 1) The Bridging should be running on the standard Intel servers on standard Virtualized platforms. The hardware, software and virtualization software should be supplied and supported by a single bidder.
- 2) From day one the bridge must provide 6 full HD video ports @1080p 30 fps and 30 audio conference ports.
- 3) All necessary hardware to support the above capacity needs to be supplied from day one. Bridge must have a redundant power supply.
- 4) All the 10 ports must be able to connect different sites at different bandwidths and protocols. H.264 AVC standard must be supported at the minimum to connect all the 10 sites.
- 5) The bridge should support room based video end points, users joining from browsers' supporting WebRTC and HTML5 and its own clients. In case additional components are required for this functionality, all additional components required to have this functionality has to be included in the solution
- 6) The bridge should have the capability to host meetings with internal and external participants in a secure way such that it should co-exist with the enterprise security policies
- 7) The bridge should have components such as the Web Server for Web RTC, Scheduler as part of the offering from day one.
- 8) Should support H.263, H.263+, H.263++, H.264, WebRTC video algorithms
- 9) Should support video resolution from SD to Full HD to join into a conference
- 10) Along with the Support for basic algorithms like G.711 and G.722.1 the bridge should also support wideband Audio protocols like MPEG 4 AAC - LC / MPEG 4 AAC – LD

- 11) Must support the ability to allow Video conferencing devices, Clients on Mobile phones, Smart phones and Laptops to join into conference. These clients can be inside the WAN network or even on the Internet without a VPN.
- 12) The bridge should support transcoding of different Audio/video Protocols.
- 13) The bridge should have H.239/BFCP protocol for sending and receiving dual video streams (Presenter + Presentation).
- 14) The bridge must also support advanced continuous presence such that the site that is "on-air" to be seen on a larger window and the other sites are seen in smaller quadrants
- 15) The bridge must be a secure Non-PC Hardware with a strong operating system. The Hardware and software must be from the same OEM.
- 16) The bridge should support 128 Bit strong AES encryption for calls and H.235/SHA1 for authentication
- 17) It should be possible for outside agencies (for state government, central government, police department, etc.) to join the bridge for multi-party video conference call securely over internet.
- 18) They should be able to join the bridge using standards based VC endpoints using internet (as long as these endpoints are exposed to internet) securely.
- 19) It should be possible to connect 5 such external endpoints / locations concurrently at any given point of time.
- 20) It should use secure firewall traversal technology.
- 21) It should support any standards-compliant SIP or H.323 video conferencing endpoints.
- 22) It should support for H.323 SIP Interworking Encryption and H.323 SIP Interworking Duo Video
- 23) It should use standards based firewall traversal methods - H.460.18/19

3.11.14 Fixed Dome Camera for Indoor Surveillance

#	Parameter	Minimum Specifications or better	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make		<to be provided by the bidder>	
2.	Model		<to be provided by the bidder>	
3.	Video Compression	H.264		
4.	Video Resolution	1920 X 1080		
5.	Frame rate	Min. 25 fps		

6.	Image Sensor	1/3" Progressive Scan CCD / CMOS		
7.	Lens Type	Varifocal, IR Correction Full HD lens compatible to camera imager		
8.	Lens#	Auto IRIS 2.8-10mm		
9.	Multiple Streams	Dual streaming with 2 nd stream at minimum 720P at 30fps at H.264 individually configurable		
10.	Minimum Illumination	Colour: 0.1 lux, B/W: 0.01 lux (at 30 IRE)		
11.	IR Cut Filter	Automatically Removable IR-cut filter		
12.	Day/Night Mode	Colour, Mono, Auto		
13.	S/N Ratio	≥ 50 dB		
14.	Auto adjustment + Remote Control of Image settings	Colour, brightness, sharpness, contrast, white balance, exposure control, backlight compensation, Gain Control, Auto back focus		
15.	Wide Dynamic Range	True WDR upto 80 db		
16.	Audio	Full duplex, line in and line out, G.711, G.726		
17.	Local storage	Minimum 32 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. 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.		
18.	Protocol	HTTP, HTTPS, FTP, RTSP, RTP, TCP, UDP, RTCP, DHCP, ONVIF Profile S &G		
19.	Security	Password Protection, IP Address filtering, User Access Log, HTTPS encryption		
20.	Intelligent Video	Motion Detection & Tampering alert		
21.	Alarm I/O	Minimum 1 Input & Output contact for 3 rd part interface		
22.	Operating conditions	0 to 50°C		
23.	Casing	NEMA 4X / IP-66 rated & IK 10		
24.	Certification	UL/EN, CE,FCC		
25.	Power	802.3af PoE (Class 0) and 12VDC/24AC		

3.12 Data Centre

- This section focuses on the minimum specification required to be offered as part of the solution
- GWSCCL shall provide the location to house the compute and storage infrastructure, at the Data Center facility at the GWMC
- Bidders are expected to do the site survey of the existing facility and come up with design considerations and capacity considerations for infrastructure for facility management and support services for DC and ICCS such as NOC Room, UPS room, War room, Meeting and Manager Rooms etc.
- The DR for the data could be on cloud. The rate card, for various services offered by the cloud vendor will also be available on request. The DC and DR will be as per Tier3 / Tier 4 standards
- Various ICT equipment to be provisioned and maintained by the MSI at the Data Center & DR Sites are given below.
- As part of the bid submission bidders are expected to duly fill the compliance as per the format provided along with Product details
- Bidders can propose any additional item to complete the solution

3.12.1 Core Router

In case of a Multicast video stream base network is proposed the Bidder is suggested to consider suitable routers and switches to manage the Multicast network accordingly as per the solution proposed.

#	Item	Minimum Specifications	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make		<to be provided by the bidder>	
2.	Model		<to be provided by the bidder>	
3.	Multi-Services	Should deliver multiple IP services over a flexible combination of interfaces		
	Ports	As per overall network architecture proposed by the bidder, the router should be populated with required number of LAN/WAN ports/modules, with cable for connectivity to other network elements.		
4.	Speed	As per requirement, to cater to entire bandwidth requirement of the project.		

5.	Interface modules	Must support minimum 2* 10G Port with necessary SFP+ Modules. Must have capability to interface with variety interfaces.		
6.	Protocol Support	Must have support for TCP/IP, PPP Must support IPSEC VPN Must have support for integration of data and voice services Routing protocols of RIP, OSPF, and BGP. Support IPV4 & IPV6		
7.	Manageability	Must be SNMP manageable		
8.	Scalable	<ul style="list-style-type: none"> The router should be scalable. For each slot multiple modules should be available. The chassis offered must have free slots to meet the scalability requirement of expansion of the project in the future. 		
9.	Traffic control	Traffic Control and Filtering features for flexible user control policies		
10.	Bandwidth	To be designed and decided optimized for the solution		
11.	Remote Access	Remote access features		
12.	Redundancy	<ul style="list-style-type: none"> Redundancy in terms of Power supply(s). Power supply should be able to support fully loaded chassis All interface modules, power supplies should be hot-swappable 		
13.	QOS Features	<ul style="list-style-type: none"> RSVP Priority Queuing Policy based routing Traffic shaping Time-based QoS Policy Bandwidth Reservation / Committed Information Rate 		

3.12.2 Internet Router

#	Item	Minimum Specifications	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make		<to be provided by the bidder>	
2.	Model		<to be provided by the bidder>	
3.	Multi-Services	Should deliver multiple IP services over a flexible combination of interfaces		
4.	Ports	As per overall network architecture proposed by the bidder, the router should be populated with required number of LAN/WAN ports/modules, with cable for connectivity to other network elements.		
5.	Speed	As per requirement, to cater to entire bandwidth requirement of the project.		
6.	Interface modules	Must support minimum 2* 10G Port with necessary SFP+ Modules. Must have capability to interface with variety interfaces.		
7.	Protocol Support	Must have support for TCP/IP, PPP Must support IPSEC VPN Must have support for integration of data and voice services Routing protocols of RIP, OSPF, and BGP. Support IPV4 & IPV6		
8.	Manageability	Must be SNMP manageable		
9.	Scalable	<ul style="list-style-type: none"> The router should be scalable. For each slot multiple modules should be available. The chassis offered must have free slots to meet the scalability requirement of expansion of the project in the future. 		

10.	Traffic control	Traffic Control and Filtering features for flexible user control policies		
11.	Bandwidth	To be designed and decided optimized for the solution		
12.	Remote Access	Remote access features		
13.	Redundancy	<ul style="list-style-type: none"> Redundancy in terms of Power supply(s). Power supply should be able to support fully loaded chassis All interface modules, power supplies should be hot-swappable 		
14.	Security features	<ul style="list-style-type: none"> MD5 encryption for routing protocol NAT URL based Filtering RADIUS Authentication Management Access policy IPSec / Encryption L2TP 		
15.	QOS Features	<ul style="list-style-type: none"> RSVP Priority Queuing Policy based routing Traffic shaping Time-based QoS Policy Bandwidth Reservation / Committed Information Rate 		

3.12.3 Intrusion Prevention System

This can be offered as separate unit or as a module in firewall

#	Item	Required Specifications	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make		<to be provided by the bidder>	
2.	Model		<to be provided by the bidder>	
3.	Performance	Should have an aggregate throughput of no less than 200Mbps Total Simultaneous Sessions – 500,000		

4.	Features	<p>IPS should have Dual Power Supply</p> <p>IPS system should be transparent to network, not default gateway to Network</p> <p>IPS system should have Separate interface for secure management</p> <p>IPS system should be able to protect Multi Segment in the network, should be able to protect 4 segments.</p>		
5.	Real Time Protection	<ul style="list-style-type: none"> • Web Protection • Mail Server Protection • Cross Site Scripting • SNMP Vulnerability • Worms and Viruses • Brute Force Protection • SQL Injection • Backdoor and Trojans 		
6.	Stateful Operation	<ul style="list-style-type: none"> • TCP Reassembly • IP Defragmentation • Bi-directional Inspection • Forensic Data Collection • Access Lists 		
7.	Signature Detection	<p>Should have provision for Real Time Updates of Signatures, IPS Should support Automatic signature synchronization from database server on web Device should have capability to define User Defined Signatures</p>		
8.	Block attacks in real time	<ul style="list-style-type: none"> • Drop Attack Packets • Reset Connections • Packet Logging • Action per Attack 		
9.	Alerts	<ul style="list-style-type: none"> • Alerting SNMP • Log File • Syslog • E-mail 		
10.	Management	<ul style="list-style-type: none"> • SNMP v1, v2, v3 • HTTP/HTTPS • SSHv2, Console 		

11.	Security Maintenance	<ul style="list-style-type: none"> • IPS Should support 24/7 Security Update Service • IPS Should support Real Time signature update • IPS Should support Provision to add static own attack signatures • System should show real-time and History reports of Bandwidth 		
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3.12.4 Data Center Switch (Manageable)

(To be used for Data center LAN Switch)

#	Parameter	Minimum Specifications	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make		<to be provided by the bidder>	
2.	Model		<to be provided by the bidder>	
3.	Ports	<ul style="list-style-type: none"> • 24 or 48 (as per requirements) 10/100/1000 Base-TX Ethernet ports and extra 2 nos of Base-SX/LX ports • All ports can auto-negotiate between 10Mbps/ 100Mbps/ 1000Mbps, half-duplex or full duplex and flow control for half-duplex ports. 		
4.	Switch type	Layer 3		
5.	MAC	Support 8K MAC address.		
6.	Backplane	56 Gbps or more Switching fabric capacity (as per network configuration to meet performance requirements)		
7.	Forwarding rate	Packet Forwarding Rate should be 70.0 Mbps or better		
8.	Port Features	Must support Port Mirroring, Port Trunking and 802.3ad LACP Link Aggregation port trunks		
9.	Flow Control	Support IEEE 802.3x flow control for full-duplex mode ports.		
10.	Protocols	<ul style="list-style-type: none"> • Support 802.1D, 802.1S, 802.1w, Rate limiting 		

		<ul style="list-style-type: none"> • Support 802.1Q VLAN encapsulation, IGMP v1, v2 and v3 snooping • 802.1p Priority Queues, port mirroring, DiffServ • Support based on 802.1p priority bits with at least 8 queues • DHCP support & DHCP snooping/relay/optional 82/ server support • Shaped Round Robin (SRR) or WRR scheduling support. • Support for Strict priority queuing & Sflow • Support for IPV6 ready features with dual stack • Support up-to 255 VLANs and up-to 4K VLAN IDs 		
11.	Access Control	<ul style="list-style-type: none"> • Support port security • Support 802.1x (Port based network access control). • Support for MAC filtering. • Should support TACACS+ and RADIUS authentication 		
12.	VLAN	<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 		
13.	Protocol and Traffic	<ul style="list-style-type: none"> • 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 		

14.	Management	<ul style="list-style-type: none"> • Switch needs to have RS-232 console port for management via a console terminal or PC • Must have support SNMP v1,v2 and v3 • Should support 4 groups of RMON • Should have accessibility using Telnet, SSH, Console access, easier software upgrade through network using TFTP etc. Configuration management through CLI, GUI based software utility and using web interface 		
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3.12.5 Data Center Switch

(To be used as Top of the Rack (TOR) switch if required)

#	Parameter	Minimum Specifications	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make		<to be provided by the bidder>	
2.	Model		<to be provided by the bidder>	
3.	Ports	<ul style="list-style-type: none"> • 24 or 48 (as per density required) 1G/ 10G Ethernet ports (as per internal connection requirements) and extra 2 numbers of Uplink ports (40GE) • All ports can auto-negotiate between all allowable speeds, half-duplex or full duplex and flow control for half-duplex ports. 		
4.	Switch type	Layer 3		
5.	MAC	Support 32K MAC address.		
6.	Backplane	Capable of providing wire-speed switching		
7.	Throughput	500 Mbps or better		
8.	Port Features	Must support Port Mirroring, Port Trunking and 802.3ad LACP Link Aggregation port trunks		
9.	Flow Control	Support IEEE 802.3x flow control for full-duplex mode ports.		

10.	Protocols	<ul style="list-style-type: none"> • IPV4, IPV6 • Support 802.1D, 802.1S, 802.1w, Rate limiting • Support 802.1X Security standards • Support 802.1Q VLAN encapsulation, IGMP v1, v2 and v3 snooping • 802.1p Priority Queues, port mirroring, DiffServ • DHCP support • Support up to 1024 VLANs • Support IGMP Snooping and IGMP Querying • Support Multicasting • Should support Loop protection and Loop detection, • Should support Ring protection (optional) 		
11.	Access Control	<ul style="list-style-type: none"> • Support port security • Support 802.1x (Port based network access control). • Support for MAC filtering. • Should support TACACS+ and RADIUS authentication 		
12.	VLAN	<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 		
13.	Protocol and Traffic	<ul style="list-style-type: none"> • 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 		

14.	Management	<ul style="list-style-type: none"> • Switch needs to have a console port for management via a console terminal or PC • Must have support SNMP v1,v2 and v3 • Should support 4 groups of RMON • Should have accessibility using Telnet, SSH, Console access, easier software upgrade through network using TFTP etc. Configuration management through CLI, GUI based software utility and using web interface 		
15.	Resiliency	<ul style="list-style-type: none"> • Dual load sharing AC and DC power supplies • Redundant variable-speed fans 		

3.12.6 Server Load balancer

S.No	Parameter	General Requirement
1	Server Load Balancing Mechanism	<ul style="list-style-type: none"> • Cyclic, Hash, Least numbers of users • Weighted Cyclic, Least Amount of Traffic • NT Algorithm / Private Algorithm / Customizable Algorithm / Response Time
2	Redundancy Features	<ul style="list-style-type: none"> • Supports Active-Active and Active-Standby Redundancy • Segmentation / Virtualization support along with resource allocation per segment, dedicated access control for each segment
3	Routing Features	<ul style="list-style-type: none"> • Routing protocols RIPv1/RIPv2/OSPF • Static Routing policy support
4	Server Load Balancing Features	<ul style="list-style-type: none"> • Server and Client process coexist • UDP Stateless • Service Failover • Backup/Overflow • Direct Server Return • Client NAT • Port Multiplexing-Virtual Ports to Real Ports Mapping • DNS Load Balancing
5	Load Balancing Applications	<ul style="list-style-type: none"> • Application/ Web Server, MMS, RTSP, Streaming Media

		<ul style="list-style-type: none"> • DNS, FTP- ACTIVE & PASSIVE, REXEC, RSH, • LDAP, RADIUS <ul style="list-style-type: none"> • Content Intelligent SLB • HTTP Header Super Farm • URL-Based SLB • Browser Type Farm • Support for Global Server Load Balancing • Global Server Load Balancing Algorithms • HTTP, HTTP Redirection, • DNS Redirection, RTSP Redirection • DNS Fallback Redirection, HTTP Layer 7 Redirection
6	SLB should support below Management options	<ul style="list-style-type: none"> • Secure Web Based Management • SSH • TELNET • SNMP v1, 2, 3 Based GUI • Command Line

1. Shall support minimum four (4) virtual instances and shall be scalable to 16 instances on the same appliance.
2. Shall have minimum of 14 Gbps of system throughput per virtual instance to support multiple load balancing and security functions.
3. Shall have minimum of 8x10G SFP+ interfaces from day one.
4. Shall have security features like reverse-proxy firewall, sync-flood and denial of service attack protection from day one

3.12.7 Servers (As Building block, to establishing computing solution for sub-systems/solutions)

#	Parameter	Minimum Specifications	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make		<to be provided by the bidder>	
2.	Model		<to be provided by the bidder>	
3.	Processor	Latest series/ generation of 64 bit x86 processor(s) with Ten or higher Cores Processor speed should be minimum 2.4 GHz Minimum 2 processors per each physical server		
4.	RAM	Minimum 32 GB Memory per physical server scalable upto 256 GB		
5.	Internal Storage	2 x 300 GB SAS (10k rpm) hot swap		

6.	Network interface	4 X 10GbE LAN ports for providing Ethernet connectivity Optional: 1 X Dual-port 16Gbps FC HBA (or FCoE) for providing FC connectivity		
7.	Power supply	Dual Redundant Power Supply		
8.	RAID support	As per requirement/solution		
9.	Operating System	Licensed version of 64 bit latest version of Linux/ Microsoft® Windows based Operating system)		
10.	Form Factor	Rack mountable		
11.	Virtualization	Shall support Industry standard virtualization hypervisor like Hyper-V, VMWARE, Oracle VM etc. In case the MSI proposes the solution to virtualization, then they should propose suitable associated management solution to meet or exceed the SLAs.		

3.12.8 Storage

The estimated Storage requirement for all the components for this project is as below:

#	Minimum Storage Requirement	TB
1	Primary Storage	160
2	Secondary Storage	700
3	Back up Storage	140
	Total	1000

Note:

- Bidder is expected to carry out the storage requirement estimation and supply as per the solution proposed, if the estimation is more than above specified. They may also refer the bandwidth estimation and storage functional requirements as provided in this Volume.
- Bidder may supply the storage in modular manner during the implementation (i.e. initially to cater to Phase I cameras, then to further phases).

3.12.9 Storage Specifications

#	Parameter	Minimum Specifications	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make	<to be provided by the bidder>		
2.	Model	<to be provided by the bidder>		
3.	Solution/ Type	<ul style="list-style-type: none"> IP Based/iSCSI/FC/NFS/CIFS If bidder is offering FCoE based solution, corresponding ports must be present in server as well as storage controller. 		
4.	Storage	<ul style="list-style-type: none"> Storage Capacity should be as per Overall Solution Requirement (usable, after configuring in offered RAID configuration) RAID solution offered must protect against double disc failure. Disks should be preferably minimum of 1.2 TB capacity for SSD / SAS and 3 TB for SATA/ NL-SAS (combination as per performance and SLA requirements of overall solution) To store all types of data (Data, Voice, Images, Video, etc) Proposed Storage System should be scalable (vertically/horizontally) 		
5.	Hardware Platform	<ul style="list-style-type: none"> Rack mounted form-factor Modular design to support controllers and disk drives expansion 		
6.	Controllers	<ul style="list-style-type: none"> 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. 		
7.	RAID support	<ul style="list-style-type: none"> Should support various RAID Levels 		

8.	Cache	<ul style="list-style-type: none"> • Minimum 64 GB of useable cache across all controllers. If cache is provided in additional hardware for the storage solution, then cache must be over and above 64 GB. 		
9.	Redundancy and High Availability	<ul style="list-style-type: none"> • The Storage System should be able to protect the data against single point of failure with respect to hard disks, connectivity interfaces, fans and power supplies 		
10.	Management software	<ul style="list-style-type: none"> • 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 plugged in in the future, upto max capacity of the existing controller/units. • A single command console for 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 		
11.	Data Protection	<p>The storage array must have 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</p>		

3.12.10 Secondary Storage

#	Parameter	Minimum Specifications	Bidder Compliance (Yes/No)	Product Documentation Reference
1	Make	<to be provided by the bidder>		
2	Model	<to be provided by the bidder>		
3	Solution/Type	<ul style="list-style-type: none"> Secondary Storage (Archival/Backup) can be on any media such as Disks, Disk systems, etc. or its combination along with all associate software. (so as to arrive at lower cost per TB) Minimum 70% usable as secondary storage May or may not use de-duplication technology Compatible with primary storage Must use latest stable technology platform, with support available for next 5 years. 		
4	Backup Size	<p>To store data as required, to meet the archival requirement for different type of data/information</p> <ul style="list-style-type: none"> 23 days of storage for surveillance camera feeds 83 days of storage for traffic enforcement systems 275 days of storage for ATCS systems 		
5	Hardware Platform	<ul style="list-style-type: none"> Rack mounted, Rack based Expansion shelves 		
6	Software Platform	Must include backup/archive application portfolio required		
7	Retrieval time	Retrieval time for any data stored on secondary storage should be max. 4 hours for critical data & 8 hours for other data. This would be taken into account for SLA calculation. (Critical data means any data needing urgent attention by the Judicial		

		System or by Police Dept. for investigation / terrorist treat perception).		
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3.12.11 Fire proof enclosure

The overall design of 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

#	Item	Minimum Specifications	Bidder Compliance (Yes/No)	Product Documentation Reference
1	Make		<to be provided by the bidder>	
2	Model		<to be provided by the bidder>	
3	Capacity	300 Litres		
4	Temperature to Withstand	1000° C for at least 1 hour		
5	Internal Temperature	30° C after exposure to high temperature For 1 hour		
6	Locking	2 IO-lever high security cylindrical / Electronic lock		

3.12.12 KVM Module

#	Item	Minimum Specifications	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make		<to be provided by the bidder>	
2.	Model		<to be provided by the bidder>	
3.	KVM Requirement	Keyboard, Video Display Unit and Mouse Unit (KVM) for the IT Infrastructure Management at Data Center		
4.	Form Factor	19" rack mountable		
5.	Ports	minimum 8 ports		
6.	Server Connections	USB or KVM over IP.		
7.	Auto-Scan	It should be capable to auto scan servers		
8.	Rack Access	It should support local user port for rack access		

9.	SNMP	The KVM switch should be SNMP enabled. It should be operable from remote locations		
10.	OS Support	It should support multiple operating system		
11.	Power Supply	It should have dual power with failover and built-in surge protection		
12.	Multi-User support	It should support multi-user access and collaboration		

3.12.13 Server/Networking rack specifications

#	Parameter	Minimum Specifications	Bidder Compliance (Yes/No)	Product Documentation Reference
1.	Make		<to be provided by the bidder>	
2.	Model		<to be provided by the bidder>	
3.	Type	<ul style="list-style-type: none"> • 19" 42U racks mounted on the floor • Floor Standing Server Rack - 42U with Heavy Duty Extruded Aluminum 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. • 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 		
4.	Wire managers	Two vertical and four horizontal		

5.	Power Distribution Units	<ul style="list-style-type: none"> • 2 per rack • Power Distribution Unit - Vertically Mounted, 32AMPS with 25 Power Outputs. (20 Power outs of IEC 320 C13 Sockets & 5 Power outs of 5/15 Amp Sockets), Electronically controlled circuits for Surge & Spike protection, LED readout for the total current being drawn from the channel, 32AMPS MCB, 5 KV AC isolated input to Ground & Output to Ground 		
6.	Doors	<ul style="list-style-type: none"> • 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. 		
7.	Fans and Fan Tray	<ul style="list-style-type: none"> • Fan 90CFM 230V AC, 4" dia (4 Nos. per Rack) • Fan Housing Unit 4 Fan Position (Top Mounted) (1 no. per Rack) - Monitored - Thermostat based - The Fans should switch on based on the Temperature within the rack. The temperature setting should be factory settable. This unit should also include - humidity & temperature sensor 		
8.	Metal	Aluminum extruded profile		
9.	Side Panel	Detachable side panels (set of 2 per Rack)		

3.12.14 Enterprise Management Systems (EMS)

To ensure that ICT systems are delivered at the performance level envisaged, it is important that an effective monitoring and management system be put in place. It is thus proposed that a proven Enterprise Management System (EMS) is proposed by the bidder for efficient management of the system, reporting, SLA monitoring and resolution of issues. Various key components of the EMS to be implemented as part of this engagement are –

1. Network Monitoring System
2. Server Monitoring System
3. Helpdesk System

The solution should provide a unified web based console which allows role based access to the users.

1. Network Management System

Solution should provide fault & performance management of the server side infrastructure and should monitor IP\SNMP enabled devices like Routers, Switches, PA System, Emergency Call Boxes, Sensors, etc. Proposed Network Management shall also help monitor key KPI metrics like availability, in order to measure SLA's. Following are key functionalities that are required which will assist administrators to monitor network faults & performance degradations in order to reduce downtimes, increase availability and take proactive actions to remediate & restore network services.

#	Description	Bidder Compliance (Yes/No)	Product Documentation Reference
1	Make	<to be provided by the bidder>	
2	Model	<to be provided by the bidder>	
3	The proposed solution must automatically discover manageable elements connected to the infrastructure and map the connectivity between them. Solution should provide centralized monitoring console displaying network topology map.		
4	Proposed solution should provide customizable reporting interface to create custom reports for collected data		
5	The system must use advanced root-cause analysis techniques and policy-based condition correlation technology (at network level) for comprehensive analysis of infrastructure faults.		
6	The system should be able to clearly identify configuration changes and administrators should receive an alert in such cases.		
7	The solution should support multicast protocols too, if the overall project solution offered includes multicast.		

2. Server Performance Monitoring System

#	Description	Bidder Compliance (Yes/No)	Product Documentation Reference
1	Make	<to be provided by the bidder>	
2	Model	<to be provided by the bidder>	
3	The proposed tool should integrate with network performance management system and support operating system monitoring for various platforms supplied as part of this Project.		
4	The proposed tool must provide information about availability and performance for target server nodes.		
5	The proposed tool should be able to monitor various operating system parameters such as processors, memory, files, processes, file systems, etc. where applicable.		
6	If the offered server/computing solution includes virtualization, then the server performance monitoring solution must include virtualization monitoring capabilities.		

3. Centralized Helpdesk System

#	Description	Bidder Compliance (Yes/No)	Product Documentation Reference
1	Make	<to be provided by the bidder>	
2	Model	<to be provided by the bidder>	
3	Helpdesk system should provide incident management, problem management templates along with helpdesk SLA system for tracking SLA's pertaining to incident resolution time for priority / non-priority incidents.		
4	System should also automatically create tickets based on alarm type		
5	The proposed helpdesk solution must provide flexibility of logging, viewing, updating and closing incident via web interface for issues related to the project.		
6	IT Asset database should be built and managed by the bidder, in order to carry out the scope of work items.		

3.12.15 Centralized Anti-virus Solution

The following features are required for centralized anti-virus solution, to protect all computing resources (servers, desktops, other edge level devices, etc.):

- 1) Ability to scan through all file types and various compression formats. Ability to scan for HTML, VBScript Viruses, malicious applets and ActiveX controls.
- 2) Must update itself over internet for virus definitions, program updates etc. (periodically as well as in push-updates in case of outbreaks)
- 3) Able to perform different scan Actions based on the virus type (Trojan/ Worm, Joke, Hoax, Virus, other)
- 4) Shall provide Real-time product Performance Monitor and Built-in Debug and Diagnostic tools, and context- sensitive help.
- 5) The solution must provide protection to multiple remote clients
- 6) Shall provide for virus notification options for Virus Outbreak Alert and other configurable Conditional Notification.
- 7) Should be capable of providing multiple layers of defense
- 8) Shall have facility to clean, delete and quarantine the virus affected files.
- 9) Should support online update, where by most product updates and patches can be performed without bringing messaging server off-line.
- 10) Should support in-memory scanning so as to minimize Disk IO.
- 11) Should support Multi-threaded scanning
- 12) Should support scanning of nested compressed files
- 13) Should support heuristic scanning to allow rule-based detection of unknown viruses
- 14) All binaries from the vendor that are downloaded and distributed must be signed and the signature verified during runtime for enhanced security.

3.12.16 Database Licenses

Bidder needs to provide Licensed RDBMS, enterprise/full version as required for the proposed Surveillance System and following all standard industry norms for performance, data security, authentication and database shall be exportable in to XML.

3.12.17 Backup Software

1. The software shall be primarily used to back up the necessary and relevant video feeds from storage that are marked or flagged by the Police. The other data that would require backing up would include the various databases that shall be created for the surveillance system. Details of data that would be created are available in the table at section 'Data Requirements'
2. Scheduled unattended backup using policy-based management for all Server and OS platforms
3. The software should support on-line backup and restore of various applications and Databases

4. The backup software should be capable of having multiple back-up sessions simultaneously
5. 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
6. The backup software should support different types of user interface such as GUI, Web-based interface

3.12.18 Directory services

1. Should be compliant with LDAP v3
2. Support for integrated LDAP compliant directory services to record information for users and system resources
3. Should provide authentication mechanism across different client devices / PCs
4. Should provide support for Group policies and software restriction policies
5. Should support security features, such as Kerberos, Smart Cards, Public Key Infrastructure (PKI)
6. Should provide support for X.500 naming standards
7. Should support that password reset capabilities for a given group or groups of users can be delegated to any nominated user
8. Should support that user account creation/deletion rights within a group or groups can be delegated to any nominated user
9. Should support directory services integrated DNS zones for ease of management and administration/replication.

3.12.19 Structured Cabling Components

#	Parameter	Minimum Specifications	Bidder Compliance (Yes/No)
1.	Standards	ANSI TIA 568 C for all structured cabling components	
2.	OEM Warranty	OEM Certification and Warranty of 15-20 years as per OEM standards	
3.	Certification	UL Listed and Verified	

3.12.20 Electrical cabling component

#	Parameter	Minimum Specifications	Bidder Compliance (Yes/No)
1.	Standards	All electrical components shall be design manufactured and tested in accordance with relevant Indian standards IEC's	

3.13 Non-IT Requirement Specifications

- The selected bidder should adhere to the specifications given below for Non-IT components. It is essential that Fire Proof material be used as far as possible and Certification from Fire Department be taken for Command Centres before Go-Live.
- Bidder should propose Fire suppression system as per NFPA guidelines
- Furniture and Fixtures for operators should be proposed to suit 24 X 7 operations and control room norms
- It is suggested that the bidder follows the control room norms specified in ISO 11064 specifications for ergonomics, workstations, display and design of consoles, operator workstation area etc.
- Bidders can propose any additional item to complete the requirement

3.13.1 Civil and Architectural work

A.	False Ceiling (at Command Centres)	
1	Providing and fixing metal false ceiling with powder coated 0.5mm thick hot dipped galvanised steel tiles 595 x 595 mm with regular edge (10mm) suitable for 25mm grid supported on suitable powder coated galvanised steel grid as per manufacturer specification. The same shall be inclusive of cut outs for lighting, AC grills, Fire detectors, nozzles, etc.	
2	Providing and fixing 12 mm thick fire line Gypsum false ceiling and lighting troughs 300 mm as per design including 100 mm high cornices as lighting pelmets on G.I. frame work, in G.I. vertical supports at every 450mm c/c and horizontal runners at every 900mm c/c self-taping metal screws to proper line and level. The same shall be inclusive of making holes and required framing for fixing electrical fixtures, A.C. grills etc. GI vertical supports to be anchored to slab by means of anchor fasteners.	
B.	Furniture and Fixture	
1	Workstation size of min. 18" depth made with 1.5mm thick laminate of standard make over 18mm thick commercial board complete with wooden beading 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 drawer slides, hinges, locks etc.	
2	Providing & making of storage unit with 18 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	
3	Cabin table of min. depth 2' made with 1.5mm thick laminate of standard make over 19mm thick commercial board complete with wooden beading including cutting holes & fixing of cable manager etc. complete with French polish.	
4	Providing, making & fixing 6" high laminated strip using 1.5mm 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.	
5	Providing, making & fixing an enclosure for gas cylinder of Shutters and Partitions along with wooden support and 18 mm thick MDF board along with 1.5 mm approved laminate colour outside and 2 coat of enamel paint inside the shutter. 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.	
6	Should support 24*7 operations and control room operations	
C.	Partitions (wherever required as per approved drawing)	
1	Providing and fixing in position 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.	
2	With glazing including the framework of 4" x 2" powder coated aluminium section complete (in areas like partition between server room & other auxiliary areas).	

3	Providing & fixing Fire Rated Wire Glass minimum 6 mm thick for all glazing in the partition wall complete. (External windows not included in this).	
4	All doors should be minimum 1200 mm (4 ft.) wide.	
D.	Flooring (wherever required as per approved drawing)	
1	The MSI shall procure and install a raised floor to match the floor height and room aesthetic in accordance with the approved final layout and design. The MSI shall consider standard parameters for developing the final height, width, point of load, and uniform distribution load of the raised floor for the rooms based on type of furniture and overall load.	
2	The MSI shall ensure the following features and parameters are considered while designing and commissioning the raised floor: <ol style="list-style-type: none"> 1. Point of Load (PoL) shall be considered 20% more than the actual load 2. Uniform Distribution Load shall be calculated according to the final Point of Load 3. Noise-proof 4. Fireproof 5. Maintenance window for easy access to under the raised floor 6. Separate electrical and data cable tray under the raised floor 7. Face of floor tiles shall conform to the aesthetic part of the approved design 	
3	The MSI shall perform load test and noise test of the constructed raised floor.	
4	The MSI shall complete the following requirements for the raised flooring panels: <ol style="list-style-type: none"> 1. Floor shall be designed for standard load conforming to BIS 875-1987. 2. Panels shall be made up of 18-gauge steel of 600 mm × 600 mm size treated for corrosion and coated with epoxy conductive paint (minimum thickness 50 Micron). 3. Raised flooring covering shall be antistatic, high-pressure laminate, two (2) mm thick in approved 	

	shade and color with PVC trim edge. It shall not make any noise while walking on it or moving equipment. Load and stress tests on floor panels shall be performed as part of acceptance testing.	
E.	Painting	
1	Providing and applying 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.	
2	For all vertical Plain surface.	
3	For fire line gyp-board ceiling.	
4	Providing and laying 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.	
5	Applying approved fire retardant coating on all vertical surfaces, furniture etc. as per manufacturer's specification.	

3.13.2 PVC Conduit

#	Description	Bidder Compliance (Yes/No)
1.	The conduits for all systems shall be high impact rigid PVC heavy-duty type and shall comply with I.E.E regulations for non-metallic conduit 1.6 mm thick as per IS 9537/1983.	
2.	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.	
3.	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.	

4.	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.	
5.	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 and junction boxes. Bending radius shall comply with I.E.E regulations for PVC pipes.	
6.	Conduit concealed in the ceiling slab shall run parallel to walls and beams and conduit concealed in the walls shall run vertical or horizontal.	
7.	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 course sand.	

3.13.3 Wiring

#	Description	Bidder Compliance (Yes/No)
1.	PVC insulated copper conductor cable shall be used for sub circuit runs from the distribution boards to the points and shall be pulled into conduits. They shall be stranded copper conductors with thermoplastic insulation of 650 / 1100 volts grade. Colour code for wiring shall be followed.	
2.	Looping system of wiring shall be used, wires shall not be jointed. No reduction of strands is permitted at terminations.	
3.	Wherever wiring is run through trunking or raceways, the wires emerging from individual distributions shall be bunched together with cable straps at required regular intervals. Identification ferrules indication the circuit and D.B. number shall be used for sub main, sub circuit wiring the ferrules shall be provided at both end of each sub main and sub-circuit.	
4.	Where, single phase circuits are supplied from a three phase and a neutral distribution board, no conduit shall contain wiring fed from	

	more than one phase in any one room in the premises, where all or part of the electrical load consists of lights, fans and/or other single phase current consuming devices, all shall be connected to the same phase of the supply.	
5.	Circuits fed from distinct sources of supply or from different distribution boards or M.C.B.s shall not be bunched in one conduit. In large areas and other situations where the load is divided between two or three phases, no two single-phase switches connected to difference phase shall be mounted within two meters of each other.	
6.	All splicing shall be done by means of terminal blocks or connectors and no twisting connection between conductors shall be allowed.	
7.	Metal clad sockets shall be of die cast non-corroding zinc alloy and deeply recessed contact tubes. Visible scraping type earth terminal shall be provided. Socket shall have push on protective cap.	
8.	All power sockets shall be piano type with associate's switch of same capacity. Switch and socket shall be enclosed in a M. S. sheet steel enclosure with the operating knob projecting. Entire assembly shall be suitable for wall mounting with Bakelite be connected on the live wire and neutrals of each circuit shall be continuous everywhere having no fuse or switch installed in the line excepting at the main panels and boards. Each power plug shall be connected to each separate and individual circuit unless specified otherwise. The power wiring shall be kept separate and distinct from lighting and fan wiring. Switch and socket for light and power shall be separate units and not combined one.	
9.	Balancing of circuits in three phases installed shall be arranged before installation is taken up. Unless otherwise specified not more than ten light points shall be grouped on one circuit and the load per circuit shall not exceed 1000 watts.	

3.13.4 Cable Work

#	Description	Bidder Compliance (Yes/No)
1.	PVC insulated copper conductor cable shall be used for sub circuit runs from the distribution boards to the points and shall be pulled into conduits. They shall be stranded copper conductors with thermoplastic insulation of 650 / 1100 volts grade. Colour code for wiring shall be followed.	
2.	Looping system of wring shall be used, wires shall not be jointed. No reduction of strands is permitted at terminations.	

3.	Wherever wiring is run through trunking or raceways, the wires emerging from individual distributions shall be bunched together with cable straps at required regular intervals. Identification ferrules indication the circuit and D.B. number shall be used for sub main, sub circuit wiring the ferrules shall be provided at both end of each sub main and sub-circuit.	
4.	Where, single phase circuits are supplied from a three phase and a neutral distribution board, no conduit shall contain wiring fed from more than one phase in any one room in the premises, where all or part of the electrical load consists of lights, fans and/or other single phase current consuming devices, all shall be connected to the same phase of the supply.	
5.	Circuits fed from distinct sources of supply or from different distribution boards or M.C.B.s shall not be bunched in one conduit. In large areas and other situations where the load is divided between two or three phases, no two single-phase switches connected to difference phase shall be mounted within two meters of each other.	
6.	All splicing shall be done by means of terminal blocks or connectors and no twisting connection between conductors shall be allowed.	
7.	Metal clad sockets shall be of die cast non-corroding zinc alloy and deeply recessed contact tubes. Visible scraping type earth terminal shall be provided. Socket shall have push on protective cap.	
8.	All power sockets shall be piano type with associate's switch of same capacity. Switch and socket shall be enclosed in a M. S. sheet steel enclosure with the operating knob projecting. Entire assembly shall be suitable for wall mounting with Bakelite be connected on the live wire and neutrals of each circuit shall be continuous everywhere having no fuse or switch installed in the line excepting at the main panels and boards. Each power plug shall be connected to each separate and individual circuit unless specified otherwise. The power wiring shall be kept separate and distinct from lighting and fan wiring. Switch and socket for light and power shall be separate units and not combined one.	
9.	Balancing of circuits in three phases installed shall be arranged before installation is taken up. Unless otherwise specified not more than ten light points shall be grouped on one circuit and the load per circuit shall not exceed 1000 watts.	

3.13.5 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. Earthing shall be in conformity with provision of rules 32, 61, 62, 67 & 68 of Indian Electricity rules 1956 and as per IS-3043. The entire applicable IT infrastructure in the Control Rooms shall be earthed.

#	Description	Bidder Compliance (Yes/No)
1.	Earthing should be done for the entire power system and provisioning should be there to earth UPS systems, Power distribution units, and AC units etc. so as to avoid a ground differential. State shall provide the necessary space required to prepare the earthing pits.	
2.	All metallic objects on the premises that are likely to be energized by electric currents should be effectively grounded.	
3.	The connection to the earth or the electrode system should have sufficient low resistance in the range of 0 to 25 ohm to ensure prompt operation of respective protective devices in event of a ground fault, to provide the required safety from an electric shock to personnel & protect the equipment from voltage gradients which are likely to damage the equipment.	
4.	Recommended levels for equipment grounding conductors should have very low impedance level less than 0.25 ohm.	
5.	In case of a UPS and Transformer equipment, the Earth resistance shall be automatically measured on an online basis at a pre-configured interval and corrective action should be initiated based on the observation. The automatic Earthing measurements should be available on the UPS panel itself	
6.	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.	
7.	The earth connections shall be properly made.	
8.	A complete copper mesh earthing grid needs to be installed for the server farm area, every rack need to be connected to this earthing grid. A separate earthing pit needs to be in place for this copper mesh.	
9.	Provide separate earthing pits for servers, UPS & generators as per the standards.	

3.13.6 Fire Detection and Control Mechanism

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.

#	Description	Bidder Compliance (Yes/No)
A.	System Description	
1	The Fire alarm system shall be an automatic 1 ton (e.g. 8) zone single loop addressable fire detection and alarm system, utilizing conventional detection and alarm sounders.	
2	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.	
B.	Control and Indicating Component	
1	The control panel shall be a microprocessor based single loop addressable unit, designed and manufactured to the requirements of EN54 Part 2 for the control and indicating component and EN54 Part 4 for the internal power supply.	
2	All controls of the system shall be via the control panel only.	
3	The system status shall be made available via panel mounted LEDs and a backlit 8 line x 40-character alphanumeric liquid crystal display.	
4	All system controls and programming will be accessed via an alphanumeric keypad. The control panel will incorporate form fill menu driven fields for data entry and retrieval.	
5	The system will include a detection verification feature. The user shall have the option to action a time response to a fire condition. This time shall be programmable up to 10 minutes to allow for investigation of the fire condition before activating alarm outputs. The operation of a manual call point shall override any verify command.	
C.	Manual Controls	
1	Start sounders	
2	Silence sounders	
3	Reset system	
4	Cancel fault buzzer	
5	Display test	
6	Delay sounder operation	
7	Verify fire condition	
8	Disable loop	

D.	Smoke detectors	
1	Smoke detectors shall be of the optical or ionisation type. Devices shall be compatible with the CIE conforming to the requirements of EN54 Part 7 and be LPCB approved. The detectors shall have twin LEDs to indicate the device has operated and shall fit a common addressable base.	
2	Heat detectors	
3	Heat detectors shall be of the fixed temperature (58° C) or rate of temperature rise type with a fixed temperature operating point.	
4	Devices shall be compatible with the CIE conforming to the requirements of EN54 Part 5 and be LPCB approved.	
5	The detectors shall have a single LED to indicate the device has operated and shall fit a common addressable base.	
E.	Addressable detector bases	
1	All bases shall be compatible with the type of detector heads fitted and the control system component used. Each base shall comprise all necessary electronics including a short circuit isolator.	
2	The device shall be automatically addressed by the CIE on power up of the loop without the need of the insertion of a pre-programmed EPROM or setting of DIL switches.	
3	Detector bases shall fit onto an industry standard conduit box.	
F.	Audible Alarms	
1	Electronic sounders shall be coloured red with adjustable sound outputs and at least 3 sound signals. The sounders should be suitable for operation with a 24V DC supply providing a sound output of at least 100dBA at 1 meter and 75 dBA min, for a bell head or sounder base type device. The sounder frequency shall be in the range of 500Hz to 1000Hz.	
G.	Commissioning	
1	The fire detection and alarm system will be programmable and configurable via an alpha numeric keypad on the control panel.	

3.13.7 Access Control System

The Access Control System shall be deployed 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. An access control system consisting of a central PC, intelligent controllers, power supplies and all associated accessories is required to make a fully operational on line access control system. Access control shall be provided for 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. Entry to the restricted area shall be by showing a proximity card

near the reader and exit shall be using a push button installed in the secure area. The system shall monitor the status of the doors through magnetic reed contacts. The system should be designed and implemented to provide following functionality:

#	Description	Bidder Compliance (Yes/No)
1	Controlled Entries to defined access points	
2	Controlled exits from defined access points	
3	Controlled entries and exits for visitors	
4	Configurable system for user defined access policy for each access point	
5	Record, report and archive each and every activity (permission granted and / or rejected) for each access point.	
6	User defined reporting and log formats	
7	Fail safe operation in case of no-power condition and abnormal condition such as fire, theft, intrusion, loss of access control, etc.	
8	Day, Date, Time and duration based access rights should be user configurable for each access point and for each user.	
9	One user can have different policy / access rights for different access points.	

4 Annexure II: Detailed Scope of Work and Considerations

4.1 Inception Phase

The MSI will be responsible for preparation of detailed project plan. The plan shall address at the minimum the following:

1. Define an organized set of activities for the project and identify the interdependence between them.
2. Resource planning and loading for each phase/activity. This must also indicate where each resource would be based during that phase, i.e. onsite at the GWSCCL office or off site at MSI premises.
3. Establish and measure resource assignments and responsibilities
4. Highlight the milestones and associated risks
5. Communicate the project plan to stakeholders with meaningful reports.
6. Measure project deadlines and performance objectives.
7. Project Progress Reporting. During the implementation of the project, the MSI should present weekly reports. This report will be presented in the steering committee meeting to GWSCCL. The report should contain at the minimum the under mentioned:
 - a. Results accomplished during the period (weekly)
 - b. Cumulative deviations from the schedule date as specified in the finalized Project Plan
 - c. Corrective actions to be taken to return to planned schedule of progress
 - d. Plan for the next week
 - e. Proposed revision to planned schedule provided such revision is necessitated by reasons beyond the control of MSI
 - f. Support needed
 - g. Highlights/lowlights
 - h. Issues/Concerns
 - i. Risks/Show stoppers along with mitigation
8. Identify the activities that require the participation of client personnel (including GWSCCL, the Program Management Unit etc.) and communicate their time requirements and schedule early enough to ensure their full participation at the required time.

4.2 Requirement Phase

The MSI must perform the detailed assessment of the business requirements and IT Solution requirements as mentioned in this RFP. Based on the understanding and its own individual assessment, MSI shall develop & finalize the System Requirement Specifications (SRS) in consultation with GWSCCL

and its representatives. While doing so, MSI at least is expected to do following:

1. MSI shall study and revalidate the requirements given in the RFP with GWSCCL and submit as an exhaustive FRS document.
2. MSI shall develop the FRS and SRS documents.
3. MSI shall develop and follow standardized template for requirements capturing and system documentation.
4. MSI must maintain traceability matrix from SRS stage for the entire implementation.
5. MSI must get the sign off from user groups formed by GWSCCL.
6. For all the discussion with GWSCCL team, MSI shall be required to be present at GWSCCL office with the requisite team members.
7. Prior to starting the site clearance, the MSI shall carry out survey of field locations as specified in Annexure IX, for buildings, structures, fences, trees, existing installations, etc.
8. The infrastructure of existing traffic signal and other street ICT infrastructure may need to be dismantled and replaced with the new systems which are proposed and required under the scope of the project. The infrastructure like poles, cantilevers, cabling, aspects etc. should be reused to derive economies for the project with prior approval of GWSCCL. The dismantled infrastructure shall be delivered at the GWSCCL designated location without damage at no extra cost.
9. All existing road signs which are likely to be effected by the works are to be carefully taken down and stored. Signs to be re-commissioned shall be cleaned, provided with new fixings where necessary and the posts re-painted in accordance with GWSCCL guidelines. Road signs, street name plate, etc. damaged by the MSI during their operation shall be repaired or replaced by MSI at no additional cost.
10. The MSI shall directly interact with electricity boards for provision of mains power supply at all desired locations for field solution. GWSCCL shall facilitate the same.

4.3 Design Phase

The MSI shall build the solution as per the Design Considerations detailed in Annexure – IV. The solution proposed by MSI should comply with the design considerations requirements as mentioned therein.

4.4 Development Phase 1 & 2

The MSI shall carefully consider the scope of work and provide a solution that best meets the project's requirements. Considering the scope set in this RFP, the MSI shall carefully consider the solutions it proposes and explicitly mention the same in the technical proposal. The implementation of the application software will follow the procedure mentioned below:

1. Software Products (Configuration and Customization): In case MSI proposes software products the following need to be adhered:

- a. MSI will be responsible for supplying the application and licenses of related software products and installing the same so as to meet project requirements.
- b. MSI shall have provision for procurement of licenses in a staggered manner as per the actual requirement of the project.
- c. The MSI shall perform periodic audits to measure license compliance against the number of valid End User software licenses consistent with the terms and conditions of license agreements, volume purchase agreements, and other mutually agreed upon licensed software terms and conditions. The MSI shall report any exceptions to license terms and conditions at the right time to GWSCCL. However, the responsibility of license compliance solely lies with the MSI. Any financial penalty imposed on GWSCCL during the contract period due to license non-compliance shall be borne by MSI.
- d. MSI shall also supply any other tools & accessories required to make the integrated solution complete as per requirements. For the integrated solution, the MSI shall supply:
 - Software & licenses.
 - Supply tools, accessories, documentation and provide a list of the same. Tools and accessories shall be part of the solution.
 - System Documentation: System Documentation both in hard copy and soft copy to be supplied along with licenses and shall include but not limited to following. Documentation to be maintained, updated and submitted to GWSCCL regularly :
 - Functional Requirement Specification (FRS)
 - High level design of whole system
 - Low Level design for whole system / Module design level
 - System Requirements Specifications (SyRS)
 - Any other explanatory notes about system
 - Traceability matrix
 - Technical and product related manuals
 - Installation guides
 - User manuals
 - System administrator manuals
 - Toolkit guides and troubleshooting guides
 - Other documents as prescribed by GWSCCL
 - Quality assurance procedures
 - Change management histories
 - Version control data
 - SOPs, procedures, policies, processes, etc developed for GWSCCL

- Programs :
 - Entire source codes
 - All programs must have explanatory notes for understanding
 - Version control mechanism
 - All old versions to be maintained
- Test Environment :
 - Detailed Test methodology document
 - Module level testing
 - Overall System Testing
 - Acceptance test cases

(These documents need to be updated after each phase of project and to be maintained updated during entire project duration. The entire documentation will be the property of GWSCCL.)

4.5 Integration Phase 1 & 2

The Command and control center should be integrated with feeds of all tracks/component through OPC UA (OLE Platform Communication) deployed under this Project. The MSI shall provide the testing strategy including traceability matrix, test cases and shall conduct the testing of various components of the software developed/customized and the solution as a whole. The testing should be comprehensive and should be done at each stage of development and implementation.

1)	Sensor Based & Camera Based Smart Parking	a) Consolidates all city parking information onto a single operations platform. b) Should provide parking availability, revenue collection information on dashboard, which receives from various sources. c) The platform should be able to integrate any type of parking sensor irrespective of the technology used. For example, some parking sensors might use RF technology like LoRa or ZigBee to communicate the data and events, some might use GPRS or some might use Wi-Fi. Some parking sensors might use infra-red based detection, some might use magnetic field based detection or combination of the both where as some might use a video camera to detect parking occupancy. Irrespective of the technology, the platform should be able to integrate with these devices and their software managers and provide the data from such devices in a normalized and standard based data models. Viewing of CCTV feed of parking lots. d) Integration with GIS map
2)	Water- SCADA & Water Meter (Future Provision to be made)	a) The Water SCADA should be integrated into ICCC Provision to be made b) The data exchange format should be JSON/XML

		<p>c) ICCC uses an ESB or IoT API Adapter for consuming the web services from SCADA application</p> <p>d) ICCC Integration Engine stores auth. and other historic data for generating reports</p> <p>e) ICCC initially makes call to get the authentication tokens for calling web services</p> <p>f) MIS Details of following are integrated viz.,</p> <ul style="list-style-type: none"> ▪ Total Commercial Users ▪ Total Domestic Users ▪ Total Flat Rate Users ▪ Total Water Users ▪ Total Demand Raised for a month ▪ Total Payments Collected Today ▪ Total Payments Collected this month ▪ Total Pending Payments ▪ Season wise trends of water usage ▪ Projected Demand ▪ Area wise water demand/usage ▪ Peak Water Usage Days in a week/month <p>g) KPIs on Demand vs Supply, Expected Collection vs Actuals Collected</p> <p>h) Integration with GIS map</p>
3)	Power/Electricity – SCADA & Electricity Meter (Future Provision to be made)	<p>a) The Electricity SCADA should be integrated into ICCC Provision to be made for Integration</p> <p>b) The data exchange format should be JSON/XML</p> <p>c) ICCC uses an ESB or IoT API Adapter for consuming the web services from Electricity SCADA application</p> <p>d) ICCC Integration Engine stores auth and other historic data for generating reports</p> <p>e) ICCC initially makes call to get the authentication tokens for calling web services</p> <p>f) MIS Details of revenue Collection, Power Management, Usage, Peak Usage, Demand vs Distribution location wise should be integrated into the dashboard</p> <ul style="list-style-type: none"> ▪ MIS details of following are integrated into Dashboard viz., ▪ Total Commercial Users ▪ Total Domestic Users ▪ Total Flat Rate Users ▪ Total Electricity Users ▪ Total Demand Raised for a month ▪ Total Payments Collected Today ▪ Total Payments Collected this month

		<ul style="list-style-type: none"> ▪ Total Pending Payments ▪ Season wise trends of electricity usage ▪ Projected Demand ▪ Area wise electricity demand/usage ▪ Peak Electricity Usage Days in a week/month <p>g) KPIs on Demand vs Supply, Expected Collection vs Actuals Collected</p> <p>h) Integration with IPDS software.</p> <p>i) Integration with GIS map</p>
4)	GIS Based Property Tax	<p>a) The Property Tax module should be integrated into ICCC</p> <p>b) ICCC uses an ESB or IoT API Adapter for consuming the web services from Property Tax application</p> <p>c) ICCC Integration Engine stores auth and other historic data for generating reports</p> <p>d) ICCC initially makes call to get the authentication tokens for calling web services</p> <p>e) ICCC makes calls to get the required data from Urban Local Bodies (ULB) viz., City Corporation, City Municipal Council, Town Municipal etc.,</p> <p>f) ICCC expects the following services viz., Property Details per Location,</p> <p>g) ICCC displays the analytical information of property tax collections across the in a GIS map</p> <ul style="list-style-type: none"> ▪ All the below services can be integrated into ICCC ▪ Create New Property ▪ Get Property details ▪ Get Property Bill ▪ Make Payment ▪ Get Receipt <p>h) Following reports can be displayed on ICCC, if required</p> <ul style="list-style-type: none"> ▪ Demand / Collection Register ▪ Assessment Register ▪ Ward-wise / Zone-wise Recovery reports ▪ Top Defaulters Report ▪ Occupancy wise / Flat wise report' ▪ Tax-wise Recovery Details ▪ Tax-wise Demand Details ▪ Advance Payment Reports ▪ Objection / Hearing Details <p>i) Integration with GIS map</p>

5)	City Surveillance & ITMS	<ul style="list-style-type: none"> a) Integrates with existing cameras and new cameras. Should support multiple video sources from multiple locations. Platform should have no limitation in displaying the number of CCTV video sources a) Integrate and assess inputs from different sources such as CCTV, ANPR, RLVD, Speed detection systems, Traffic Violation cameras, Emergency Call Box/Panic Buttons, PA Systems, Video Analytics, and other sensors further to assist with actionable intelligence. b) CCTV, Video Analytics, and sensors further to assist with actionable intelligence. c) Should use dynamic channel coverage specifically for video stream function for efficient bandwidth usage for multiple Remote Control center d) Display module should have capability to control multi-screened display wall in sync with operator console e) Should support Fixed Type and PTZ camera. Control PTZ function from the screen to control the camera but with changing tile configuration each camera should be viewed with much lower resolution. f) The system should dynamically reduce the bit rate and bandwidth for each stream based on the viewing resolution at the remote location. g) Integration with GIS map
6)	Environmental Monitoring (sensor based) (Future Provision to be made)	<ul style="list-style-type: none"> a) Monitor key inputs from city environmental sensors like Temperature, Humidity, CO, CO2, NO2, SO2, PM10, PM2.5, b) Create awareness within the city based on dynamic inputs received from sensors and display output to various interfaces including city application, multi-services c) Integration with GIS map
7)	Smart Waste Management	<ul style="list-style-type: none"> a) Monitoring of the smart waste management system web application real-time level information for containers as well as the automatic warning system which notifies when containers require attention. b) GIS based Real-time monitoring of solid waste collection vehicles. c) Log calls/jobs on the helpdesk database utilizing helpdesk software (inquiries may be received by telephone, facsimile, email or in person). d) Track progress of waste management service requests against pre-determined KPIs. e) Maintain asset information held in the helpdesk database. f) Update site specific waste management files and other documentation for helpdesk compliance. g) Integration with control room complaints and GIS map

8)	Smart Governance (ERP) Birth & Death Module, Assets Management, Venue Booking etc.	<p>Government of Telangana is proposing to implement State wide E-Governance project The ICCC will have provision to integrate with this application to display information related various Government services For Existing Applications of Warangal Municipal Corporation the ICCC should :</p> <ul style="list-style-type: none"> a) Integrate the portal for displaying birth and death data via APIs b) Integrate with master data and other modules for information validity c) MIS Reports on Birth/Death information per location/age/gender etc. viz., <ul style="list-style-type: none"> ▪ Online Birth Certificates printed today ▪ Online Death Certificates printed today ▪ Total Birth Certificates printed ▪ Total Death Certificates printed ▪ Birth Registrations – Today ▪ Birth Registrations – Total ▪ Death Registrations – Today ▪ Death Registrations – Total ▪ Re-print requests per day/month ▪ Verification requests per day/month ▪ Pending Certificates issuance ▪ Location/Hospital wise birth/death registrations ▪ Age group wise death registrations ▪ Gender wise birth/death registrations d) Analytics on Population vs Birth/Death e) KPI's on birth and death certificate issuance by location per location f) Integration with GIS map
9)	Building Plans Approval	<ul style="list-style-type: none"> a) The building plans approval system should be integrated into ICCC b) ICCC uses an ESB or IoT API Adapter for consuming the web services from Building Plans approval application c) ICCC Integration Engine stores auth and other historic data for generating reports d) ICCC initially makes call to get the authentication tokens for calling web services e) MIS Details of buildings, registered and unregistered, demand should be integrated into the dashboard. f) Integration with GIS map

10)	Mobile App	<p>a) Provides unified northbound API to abstract diverse sensors and its attributes by single northbound API to allow interfacing and integration with existing systems.</p> <p>b) The platform should be able to normalize the data coming from different devices of same type (i.e. Different lighting sensor from different OEMs, different energy meters from different OEMs etc.) and provide secure access to that data using data API(s) to application developers.</p> <p>c) Provides Query-based language to access sensor parameter from sensor cloud</p> <p>d) Provides mechanism to translate and map business logic to sensor functionality</p> <p>e) Integration with GIS map</p>
11)	GPS	<p>a) ICCC should integrate with Vehicle tracking</p> <p>b) ICCC should Garbage vehicles, C&D Waste, Municipal sweepers, water tankers etc.</p> <p>c) Actionable alerts</p> <p>d) Summary of distance traveled by each vehicle.</p> <p>e) Violations</p> <p>f) Integration with GIS map</p>
28	HRMS	<p>a) The HRMS should be integrated into ICCC</p> <p>b) ICCC uses an ESB or IoT API Adapter for consuming the web services from HRML application</p> <p>c) ICCC Integration Engine stores auth and other historic data for generating reports</p> <p>d) ICCC initially makes call to get the authentication tokens for calling web services</p> <p>e) ICCC should integrate the MIS details of Payroll, Employee Wise Pay Summary, Department/Section wise, PF/CPF</p>

4.6 Go-Live Preparedness and Go-Live for Phase 1 & 2

1. MSI shall prepare and agree with GWSCCL, the detailed plan for Go-Live (in-line with GWSCCL's implementation plan as mentioned in RFP).
2. The MSI shall define and agree with GWSCCL, the criteria for Go-Live.
3. The MSI shall ensure that all the data migration is done from existing systems.
4. MSI shall submit signed-off UAT report (issue closure report) ensuring all issues raised during UAT are being resolved prior to Go-Live.
5. MSI shall ensure that Go –Live criteria as mentioned in User acceptance testing of Project is met and MSI needs to take approval from GWSCCL team on the same.
6. Go-live of the application shall be done as per the finalized and agreed upon Go-Live plan.

4.7 Operations and Maintenance

Success of the Project would lie on how professionally and methodically the entire Project is managed once the implementation is completed. From the MSI perspective too this is a critical phase since the quarterly payments are linked to the SLA's in the post implementation phases. MSI thus is required to depute a dedicated team of professionals to manage the Project and ensure adherence to the required SLAs. MSI shall provide operations and maintenance services for the software, hardware and other IT and Non-IT infrastructure installed as part of the project after Phase wise Go-Live and for the remaining period within 5 years after implementation or phase wise Go-Live. Warranty period of the product supplied under project i.e. hardware, software, IT/Non-IT etc., will be considered after phase wise Go-Live. The scope of work for the Operations & Maintenance Phase can be categorized under 8 service categories.

4.8 Project Management & Facilities Management Services

The MSI will be required to provide facilities management services to support the GWSCCL and Police Department officials in performing their day-to-day functions related to this system.

MSI is required to depute a dedicated, centralised project management and technical team for the overall project management and interaction with GWSCCL and Police Department.

4.9 Provision of the Operational Manpower to view the feeds at Command Center

The MSI is required to provide suitable manpower to monitor the data feeds at command centre and support GWSCCL, Traffic Police Department and any other smart solutions in operationalisation of the project. The exact role of these personnel and their responsibilities would be defined and monitored by GWSCCL and respective departmental personnel. MSI shall be required to provide such manpower meeting following requirements:

1. All such manpower shall be minimum graduate pass
2. All such manpower shall be without any criminal background / record.
3. GWSCCL reserves the right to carry out background check of the personnel proposed on the Project for verification of criminal record, at the beginning of deployment or during deployment.
4. MSI shall have to replace any person, if not found suitable for the job.
5. All the manpower shall have to undergo training from the MSI for at least 15 working days on the working of project. Training should also cover dos & don'ts and will have few sessions from GWSCCL and Traffic Police Department officers on right approaches for monitoring the feeds & providing feedback to GWSCCL, Traffic Police Personnel and other associated government agencies.
6. Each person shall have to undergo compulsory 1 day training every month
7. Operational Manpower shall work in 3 shifts, with no person being made to see the feeds for more than 8 hours at a stretch.

Detail operational guideline document shall be prepared during implementation which shall specify detail responsibilities of these resources and their do's & don'ts.

The Current estimation of the man-power required from the MSI for viewing of the data feeds is as follows:

#	Description	Quantity
1.	Operational Manpower of various other departments (Not less than 2 in shift 1)	6

The supervisors required for operationalization of the project will be provided by GWSCCL, as per requirements.

Note: The MSI will assess the requirement after due consultation with the Client.

4.10 Basic Infrastructure Services

Following services shall be provided by the MSI under the basic infrastructure services:

1. Ensure availability of the infrastructure (both physical and IT) including but not limited to Power, Cooling, Racks, Storage and other peripheral equipment installed at the time of Project commissioning as per the SLAs.
2. Ensure scalability in terms of availability of racks and supporting infrastructure.
3. Proactive and reactive maintenance, repair and replacement of defective components (physical and other peripheral IT infrastructure) installed for the Project through this RFP. The cost for repair and replacement shall be borne by the MSI.
4. Any component (Physical & IT installed at the time of Project commissioning) that is reported to be faulty / non-functional on a given date should be either fully repaired or replaced by temporary substitute (of equivalent configuration) within the time frame agreed upon in the Service Level Agreement (SLA).
5. Proactive monitoring of the entire basic infrastructure installed.
6. MSI shall maintain records of the maintenance of the basic infrastructure and shall maintain a logbook on-site that may be inspected by the GWSCCL and Traffic Police at any time.

4.11 Network Monitoring Services

The activities shall include:

1. MSI shall provide services for management of Warangal Smart City Project to maintain performance at optimum levels on a 24 x 7 basis.
2. MSI shall monitor and administer the network.
3. MSI shall create and modify VLAN, assignment of ports to appropriate applications and segmentation of traffic.
4. MSI shall carry out break fix maintenance of the LAN cabling or maintenance work requiring civil work.

A. Integration Testing

This shall be a black-box testing role primarily to ensure that the application to be deployed does not disrupt the operations and affect other infrastructure of the City in terms of performance and security. The technical tasks to be carried out shall be as follows:

1. Functional Testing: Ensuring that the application functionality as described by the GWSCCL and Traffic Police works adequately. The functional testing of application will necessarily be minimal as this is a core responsibility of the Supplier.
2. Performance Testing: Ensuring that the application meets expressed performance requirements on the servers located in GWSCCL by using performance test tools and performance monitoring tools.
3. Security Testing: Testing for exploitable application security weaknesses that undermine the application security or the security of the infrastructure.

B. Vendor Management Services

The activities shall include:

1. Coordination with all the project stakeholders to ensure that all Smart City activities are carried out in a timely manner.
2. MSI shall coordinate and follow-up with all the relevant vendors to ensure that the issues are resolved in accordance with the SLAs agreed upon with them.
3. MSI shall also ensure that unresolved issues are escalated to respective departments.
4. MSI shall maintain database of the various vendors with details like contact person, telephone nos., escalation matrix, response time and resolution time commitments etc.
5. MSI shall draw a consolidated quarterly SLA performance report across vendors for consideration of the GWSCCL and Traffic Police.

C. Network Management

The objective of this service is to ensure continuous operation and upkeep of the Network infrastructure of the project including all active and passive components. The selected MSI shall be responsible to coordinate with Network Service Provider for network related issues between ICCCL, DC, DR and other sub systems. The services to be provided for Network Management include:

1. Ensuring that the network is available 24x7x365 as per the prescribed SLAs for the initial 5 year of operations
2. Attending to and resolving network failures and snags.
3. Support and maintain the overall network infrastructure including but not limited to LAN passive components, routers, switches etc.
4. Configuration and backup of network devices including documentation of all configurations.
5. 24x7x365 monitoring of the network to spot the problems immediately.
6. Provide information on performance of Ethernet segments, including capacity utilization and error statistics for the segment and the top-contributing hosts, WAN links and routers.

7. Ensuring timely information to the GWSCCL and Traffic police pertaining to issues of Network Backbone

D. Physical Infrastructure Management and Maintenance Services

All the devices that will be installed in the Project as part of the physical infrastructure should be SNMP enabled and shall be centrally and remotely monitored and managed on a 24x7x365 basis. Industry leading infrastructure management solution should be deployed to facilitate monitoring and management of the Infrastructure on one integrated console. The physical infrastructure management and maintenance services shall include:

1. Proactive and reactive maintenance, repair and replacement of defective components (IT and Non-IT/ Hardware and Software). The cost for repair and replacement shall be borne by the MSI.
2. The MSI shall have to stock and provide adequate onsite and offsite spare parts and spare component to ensure that the uptime commitment as per SLA is met. To provide this service it is important for the MSI to have back to back arrangement with the OEMs. The MSI needs to provide a copy of the service level agreement signed with the respective OEMs.
3. Component that is reported to be down on a given date should be either fully repaired or replaced by temporary substitute (of equivalent configuration) within the time frame indicated in the Service Level Agreement (SLA). In case the selected MSI fails to meet the above standards of maintenance, there will be a penalty as specified in the SLA.
4. The selected MSI shall also maintain records of all maintenance of the system and shall maintain a logbook on-site that may be inspected by the GWSCCL and Traffic Police at any time.

4.12 Exit Management

1. This sets out the provisions, which will apply on expiry or termination of the Master Service Agreement, the Project Implementation, Operation and Management SLA.
2. In the case of termination of the Project Implementation and/or Operation and Management, the Parties shall agree at that time whether, and if so during what period, the provisions of this Schedule shall apply.
3. The Parties shall ensure that their respective associated entities carry out their respective obligations set out in this Exit Management Schedule.

A. Cooperation and Provision of Information

During the exit management period:

- a. The MSI will allow the GWSCCL or its nominated agency access to information reasonably required to define the then current mode of operation associated with the provision of the services to enable the GWSCCL to assess the existing services being delivered;
- b. Promptly on reasonable request by the GWSCCL, the MSI shall provide access to and copies of all information held or controlled by them which they have prepared or maintained in accordance with this agreement relating to any material aspect of the services (whether provided by the MSI or sub-contractors appointed by the MSI). The GWSCCL shall be entitled to copy of all such information. Such information shall include details pertaining to the services rendered and other performance data. The MSI shall permit the GWSCCL or its nominated agencies to have

reasonable access to its employees and facilities, to understand the methods of delivery of the services employed by the MSI and to assist appropriate knowledge transfer.

B. Confidential Information, Security and Data

- a. The MSI will promptly on the commencement of the exit management period supply to the GWSCCL or its nominated agency the following:
 - information relating to the current services rendered and customer and performance data relating to the performance of sub-contractors in relation to the services;
 - documentation relating to Intellectual Property Rights;
 - documentation relating to sub-contractors;
 - all current and updated data as is reasonably required for purposes of GWSCCL or its nominated agencies transitioning the services to its Replacement MSI in a readily available format nominated by the GWSCCL, its nominated agency;
 - all other information (including but not limited to documents, records and agreements) relating to the services reasonably necessary to enable GWSCCL or its nominated agencies, or its Replacement MSI to carry out due diligence in order to transition the provision of the Services to GWSCCL or its nominated agencies, or its Replacement MSI (as the case may be).
- b. Before the expiry of the exit management period, the MSI shall deliver to the GWSCCL or its nominated agency all new or up-dated materials from the categories set out in Schedule above and shall not retain any copies thereof, except that the MSI shall be permitted to retain one copy of such materials for archival purposes only.

C. Transfer of Certain Agreements

On request by the GWSCCL or its nominated agency the MSI shall effect such assignments, transfers, licenses and sub-licenses GWSCCL, or its Replacement MSI in relation to any equipment lease, maintenance or service provision agreement between MSI and third party lessors, vendors, and which are related to the services and reasonably necessary for the carrying out of replacement services by the GWSCCL or its nominated agency or its Replacement MSI.

General Obligations of the MSI

- a. The MSI shall provide all such information as may reasonably be necessary to effect as seamless a handover as practicable in the circumstances to the GWSCCL or its nominated agency or its Replacement MSI and which the MSI has in its possession or control at any time during the exit management period.
- b. For the purposes of this Schedule, anything in the possession or control of any MSI, associated entity, or sub-contractor is deemed to be in the possession or control of the MSI.
- c. The MSI shall commit adequate resources to comply with its obligations under this Exit Management Schedule.

D. Exit Management Plan

- a. The MSI shall provide the GWSCCL or its nominated agency with a recommended exit management plan ("Exit Management Plan") which shall deal with at least the following aspects of exit management in relation to the MSA as a whole and in relation to the Project Implementation, and the Operation and Management SLA.
 - A detailed program of the transfer process that could be used in conjunction with a Replacement MSI including details of the means to be used to ensure continuing provision of the services throughout the transfer process or until the cessation of the services and of the management structure to be used during the transfer;
 - plans for the communication with such of the MSI's sub-contractors, staff, suppliers, customers and any related third party as are necessary to avoid any material detrimental impact on the GWSCCL's operations as a result of undertaking the transfer;
 - (if applicable) proposed arrangements for the segregation of the MSI's networks from the networks employed by GWSCCL and identification of specific security tasks necessary at termination;
 - Plans for provision of contingent support to GWSCCL, and Replacement MSI for a reasonable period after transfer.
- b. The MSI shall re-draft the Exit Management Plan annually thereafter to ensure that it is kept relevant and up to date.
- c. Each Exit Management Plan shall be presented by the MSI to and approved by the GWSCCL or its nominated agencies.
- d. The terms of payment as stated in the Terms of Payment Schedule include the costs of the MSI complying with its obligations under this Schedule.
- e. In the event of termination or expiry of MSA, and Project Implementation, each Party shall comply with the Exit Management Plan.
- f. During the exit management period, the MSI shall use its best efforts to deliver the services.
- g. Payments during the Exit Management period shall be made in accordance with the Terms of Payment Schedule.
- h. This Exit Management plan shall be furnished in writing to the GWSCCL or its nominated agencies within 60 days from the Effective Date of this Agreement.

4.13 Compliance to Standards & Certifications

- a. For a large and complex set up such as the Project, it is imperative that the highest standards applicable are adhered to. In this context, the MSI will ensure that the entire Project is developed in compliance with the applicable standards.
- b. During project duration, the MSI will ensure adherence to prescribed standards as provided below:

1.	Information Security	ISO 27001
2.	IT Infrastructure Management	ITIL specifications
3.	Service Management	ISO 20000 specifications
4.	Project Documentation	IEEE/ISO/CMMi (where applicable) specifications for documentation

- c. The applications should to be cloud ready. In the event of migration of certain applications (ICCC, GIS etc.) on cloud, the MSI must ensure the Cloud Service provider is empaneled with MeITY and the Cloud data center adheres to TIA/Uptime certifications
- d. Apart from the above the MSI need to ensure compliance of the project with Government of India IT security guidelines including provisions of:
 - The Information Technology Act, 2000” and amendments thereof and
 - Guidelines and advisories for information security published by Cert-In/DeitY (Government of India) issued till the date of publishing of tender notice. Periodic changes in these guidelines during project duration need to be complied with.
- e. While writing the source code for application modules the MSI should ensure high-quality documentation standards to improve the readability of the software module. An illustrative list of comments that each module contained within the source file should be preceded by is outlined below:
 - The name of the module
 - The date when module was created
 - A description of what the module does
 - A list of the calling arguments, their types, and brief explanations of what they do
 - A list of required files and/or database tables needed by the module
 - Error codes/Exceptions

- Operating System (OS) specific assumptions
 - A list of locally defined variables, their types, and how they are used
 - Modification history indicating who made modifications, when the modifications were made, and what was done.
- f. Apart from the above MSI needs to follow appropriate coding standards and guidelines inclusive of but not limited to the following while writing the source code -
- Proper and consistent indentation
 - Inline comments
 - Structured programming
 - Meaningful variable names
 - Appropriate spacing
 - Declaration of variable names
 - Meaningful error messages
- g. Quality Audits
- GWSCCL, at its discretion, may also engage independent auditors to audit any/some/all standards/processes. The MSI shall support all such audits as per calendar agreed in advance. The result of the audit shall be shared with the MSI who has to provide an effective action plan for mitigations of observations/non-compliances, if any.

4.14 Project Management and Governance

1. Project Management Office (PMO)

A Project Management office will be set up during the start of the project. The PMO will, at the minimum, include a designated full time Project Manager from MSI. It will also include key persons from other relevant stakeholders including members of GWSCCL and other officials/representatives by invitation. The operational aspects of the PMO need to be handled by the MSI including maintaining weekly statuses, minutes of the meetings, weekly/monthly/project plans, etc.

PMO will meet formally on a weekly basis covering, at a minimum, the following agenda items:

- a. Project Progress
- b. Delays, if any – Reasons thereof and ways to make-up lost time
- c. Issues and concerns
- d. Performance and SLA compliance reports;
- e. Unresolved and escalated issues;
- f. Project risks and their proposed mitigation plan
- g. Discussion on submitted deliverable
- h. Timelines and anticipated delay in deliverable if any

- i. Any other issues that either party wishes to add to the agenda.

During the development and implementation phase, there may be a need for more frequent meetings and the agenda would also include:

- a. Module development status
- b. Testing results
- c. IT infrastructure procurement and deployment status
- d. Status of setting up/procuring of the Helpdesk, DC hosting
- e. Any other issues that either party wishes to add to the agenda.

Bidder shall recommend PMO structure for the project implementation phase and operations and maintenance phase.

2. Helpdesk and Facilities Management Services

The MSI shall be required to establish the helpdesk and provide facilities management services to support the GWSCCL and stakeholder department officials in performing their day-to-day functions related to this system.

The MSI shall setup a central helpdesk dedicated (i.e. on premise) for the Project, This helpdesk would be operational upon implementation of the Project. Providing helpdesk/support services from a shared facility of any other party/provider is not permitted.

Functional requirements of the helpdesk management system, fully integrated with the enterprise monitoring and network management system. The system will be accessed by the stakeholder department officials for raising their incidents and logging calls for support. The detailed service levels and response time, which the MSI is required to maintain for provisioning of the FMS services are described in the Service Level Agreement of this Tender.

MSI shall deploy Manpower during implementation and O&M phases. The deployed resource shall report to GWSCCL’s Project In-charge for Smart City Project and work closely with Program Management Office of the project. Following are the minimum resources required to be deployed in the Project, however MSI may deploy additional resources based on the need of the Project and to meet the defined SLAs in this RFP:

#	Type of Resource	Minimum Quantity	Minimum Deployment during Operation and Maintenance phase
1.	Project Manager	1	100% (8*5)
2.	Solution Architect	1	Onsite Support to Project team on need basis
3.	Software Application Expert	1	100% (24*7)

4.	Network & Security – Infrastructure Expert	1	100% (24*7)
5.	Database Architect/DBA	1	100% (24*7)
6.	Manager (City Operation Room)	1	Onsite Support to Project team on need basis
7.	Server and Storage Expert	1	100% (24*7)
8.	Help Desk Executives	2	100% (24*7 – 1 in each shift)
9.	Command Center Operators	10	100% (24*7 –2 in each shift)

Note: Numbers provided for staff providing 24*7 support is excluding relievers.

The Number of CCC operators are indicative. Actual numbers must be arrived after due discussion with Client Provision may be made to hire the operators locally.

3. Steering Committee

The Steering Committee will consist of senior stakeholders from GWSCCL, its nominated agencies and MSI. MSI will nominate its Smart City vertical head to be a part of the Project Steering Committee

The MSI shall participate in monthly Steering Committee meetings and update Steering Committee on Project progress, Risk parameters (if any), Resource deployment and plan, immediate tasks, and any obstacles in project. The Steering committee meeting will be a forum for seeking and getting approval for project decisions on major changes etc.

All relevant records of proceedings of Steering Committee should be maintained, updated, tracked and shared with the Steering Committee and Project Management Office by MSI.

During the development and implementation phase of the project, it is expected that there will be at least fortnightly Steering Committee meetings. During the O&M phase, the meetings will be held at least once a quarter.

Other than the planned meetings, in exceptional cases, GWSCCL may call for a Steering Committee meeting with prior notice to the MSI.

4. Project Monitoring and Reporting

The MSI shall circulate written progress reports at agreed intervals to GWSCCL and other stakeholders. Project status report shall include Progress against the Project Management Plan, status of all risks and issues, exceptions and issues along with recommended resolution etc.

Other than the planned meetings, in exceptional cases, project status meeting may be called with prior notice to the Bidder. GWSCCL reserves the right to ask the bidder for the project review reports other than the standard weekly review reports.

5. Risk and Issue management

The MSI shall develop a Risk Management Plan and shall identify, analyse and evaluate the project risks, and shall develop cost effective strategies and action plans to mitigate those risks.

The MSI shall carry out a Risk Assessment and document the Risk profile of GWSCCL based on the risk appetite and shall prepare and share the GWSCCL Enterprise Risk Register. The MSI shall develop an issues management procedure to identify, track, and resolve all issues confronting the project. The risk management plan and issue management procedure shall be done in consultation with GWSCCL.

The MSI shall monitor, report, and update the project risk profile. The risks should be discussed with GWSCCL and a mitigation plan be identified during the project review/status meetings. The Risk and Issue management should form an agenda for the Project Steering Committee meetings as and when required.

6. Governance procedures

MSI shall document the agreed structures in a procedures manual.

7. Planning and Scheduling

The MSI will prepare a detailed schedule and plan for the entire project covering all tasks and sub tasks required for successful execution of the project. The MSI has to get the plan approved from GWSCCL at the start of the project and it should be updated every week to ensure tracking of the progress of the project.

The project plan should include the following:

- The project break up into logical phases and sub-phases;
- Activities making up the sub-phases and phases;
- Components in each phase with milestones;
- The milestone dates are decided by GWSCCL in this RFP. MSI cannot change any of the milestone completion dates. MSI can only propose the internal task deadlines while keeping the overall end dates the same. MSI may suggest improvement in project dates without changing the end dates of each activity.
- Key milestones and deliverables along with their dates including those related to delivery and installation of hardware and software;
- Start date and end date for each activity;
- The dependencies among activities;
- Resources to be assigned to each activity;
- Dependency on GWSCCL

8. License Metering / Management

The MSI shall track software usage throughout the IT setup so as to effectively manage the risk of unauthorized usage or under-licensing of software installed at the ICCCL, and DC. This may be carried out through the use of standard license metering tools.

4.15 Change Management & Control

1. Change Orders / Alterations / Variations

- a. The MSI agrees that the requirements given in the Bidding Documents are minimum requirements and are only indicative. The vendor would need to etch out the details at the time of preparing the design document prior to actual implementation. It shall be the responsibility of the MSI to meet all the requirements of technical specifications contained in the RFP and any upward revisions and/or additions of quantities, specifications sizes given in the Bidding Documents required to be made during execution of the works, shall not constitute a change order and shall be carried out without a change order and shall be carried out without any time and cost effect to Purchaser.
- b. Further upward revisions and or additions required to make MSI's selected equipment and installation procedures to meet Bidding Documents requirements expressed and to make entire facilities safe, operable and as per specified codes and standards shall not constitute a change order and shall be carried out without any time and cost effect to Purchaser.
- c. Any upward revision and/or additions consequent to errors, omissions, ambiguities, discrepancies in the Bidding Documents which the MSI had not brought out to the Purchaser's notice in his bid shall not constitute a change order and such upward revisions and/or addition shall be carried out by MSI without any time and cost effect to Purchaser.

2. Change Order

- a. The Change Order will be initiated only in case (i) the Purchaser directs in writing the MSI to include any addition to the scope of work covered under this Contract or delete any part of the scope of the work under the Contract, (ii) MSI requests to delete any part of the work which will not adversely affect the operational capabilities of the facilities and if the deletions proposed are agreed to by the Purchaser and for which cost and time benefits shall be passed on to the Purchaser, (iii) the Purchaser directs in writing the MSI to incorporate changes or additions to the technical specifications already covered in the Contract.
- b. Any changes required by the Purchaser over and above the minimum requirements given in the specifications and drawings etc. included in the Bidding Documents before giving its approval to detailed design or Engineering requirements for complying with technical specifications and changes required to ensure systems compatibility and reliability for safe operation (As per codes, standards and recommended practices referred in the Bidding Documents) and trouble free operation shall not be construed to be change in the Scope of work under the Contract.
- c. Any change order as stated in Clause 2 a. comprising an alteration which involves change in the cost of the works (which sort of alteration is hereinafter called a "Variation") shall be the Subject of an amendment to the Contract by way of an increase or decrease in the schedule of Contract Prices and adjustment of the implementation schedule if any.
- d. If parties agree that the Contract does not contain applicable rates or that the said rates are inappropriate or the said rates are not precisely applicable to the variation in question, then the

parties shall negotiate a revision of the Contract Price which shall represent the change in cost of the works caused by the Variations. Any change order shall be duly approved by the Purchaser in writing.

- e. Within ten (10) working days of receiving the comments from the Purchaser or the drawings, specification, purchase requisitions and other documents submitted by the MSI for approval, the MSI shall respond in writing, which item(s) of the Comments is/are potential changes(s) in the Scope of work of the RFP document covered in the Contract and shall advise a date by which change order (if applicable) will be submitted to the Purchaser.

3. Testing and Acceptance Criteria

- a. MSI shall demonstrate the following mentioned acceptance criteria prior to acceptance of the solution as well as during project operations phase, in respect of scalability and performance etc. The MSI may propose further detailed Acceptance criteria which the GWSCCL will review. Once GWSCCL provides its approval, the Acceptance criteria can be finalized. In case required, parameters might be revised by GWSCCL in mutual agreement with bidder and the revised parameters shall be considered for acceptance criteria. A comprehensive system should be set up that would have the capability to log & track the testing results, upload & maintain the test cases and log & track issues/bugs identified.
- b. The following table depicts the details for the various kinds of testing envisaged for the project:

Type of Testing	Responsibility	Scope of Work
System Testing	MSI	<ol style="list-style-type: none"> 1. MSI to perform System testing 2. MSI to prepare test plan and test cases and maintain it. GWSCCL may request the MSI to share the test cases and results 3. Should be performed through manual as well as automated methods 4. Automation testing tools to be provided by MSI. GWSCCL doesn't intend to own these tools
Integration Testing	MSI	<ol style="list-style-type: none"> 1. MSI to perform Integration testing 2. MSI to prepare and share with GWSCCL the Integration test plans and test cases 3. MSI to perform Integration testing as per the approved plan 4. Integration testing to be performed through manual as well as automated methods 5. Automation testing tools to be provided by MSI. GWSCCL doesn't intend to own these tools
Performance and load Testing	<ul style="list-style-type: none"> • MSI • GWSCCL/ Third Party Auditor (<ol style="list-style-type: none"> 1. MSI to do performance and load testing.

	<p>to monitor the performance testing)</p>	<ol style="list-style-type: none"> 2. Various performance parameters such as transaction response time, throughput, page loading time should be taken into account. 3. Load and stress testing of the Project to be performed on business transaction volume 4. Test cases and test results to be shared with GWSCCL. 5. Performance testing to be carried out in the exact same architecture that would be set up for production. 6. MSI need to use performance and load testing tool for testing. GWSCCL doesn't intend to own these tools. 7. GWSCCL if required, could involve third party auditors to monitor/validate the performance testing. Cost for such audits to be paid by GWSCCL.
<p>Security Testing (including Penetration and Vulnerability testing)</p>	<ul style="list-style-type: none"> • MSI • GWSCCL / Third Party Auditor (to monitor the security testing) 	<ol style="list-style-type: none"> 1. The solution should demonstrate the compliance with security requirements as mentioned in the RFP including but not limited to security controls in the application, at the network layer, network, data centre(s), security monitoring system deployed by the MSI 2. The solution shall pass vulnerability and penetration testing for rollout of each phase. The solution should pass web application security testing for the portal, mobile app and other systems and security configuration review of the infrastructure. 3. MSI should carry out security and vulnerability testing on the developed solution. 4. Security testing to be carried out in the exact same environment/architecture that would be set up for production. 5. Security test report and test cases should be shared with GWSCCL 6. Testing tools if required, to be provided by MSI. GWSCCL doesn't intend to own these tools 7. During O&M phase, penetration testing to be conducted on yearly basis and vulnerability assessment to be conducted on half-yearly basis.

		8. GWSCCL will also involve third party auditors to perform the audit/review/monitor the security testing carried out by MSI. Cost for such auditors to be paid by GWSCCL.
User Acceptance Testing of Project	<ul style="list-style-type: none"> • GWSCCL or GWSCCL appointed third party auditor 	<ol style="list-style-type: none"> 1. GWSCCL / GWSCCL appointed third party auditor to perform User Acceptance Testing 2. MSI to prepare User Acceptance Testing test cases 3. UAT to be carried out in the exact same environment/architecture that would be set up for production 4. MSI should fix bugs and issues raised during UAT and get approval on the fixes from GWSCCL / third party auditor before production deployment 5. Changes in the application as an outcome of UAT shall not be considered as Change Request. MSI has to rectify the observations.

Note:

- a. Bidder needs to provide the details of the testing strategy and approach including details of intended tools/environment to be used by MSI for testing in its technical proposal. GWSCCL does not intend to own the tools.
- b. The MSI shall work in a manner to satisfy all the testing requirements and adhere to the testing strategy outlined. The MSI must ensure deployment of necessary resources and tools during the testing phases. The MSI shall perform the testing of the solution based on the approved test plan, document the results and shall fix the bugs found during the testing. It is the responsibility of MSI to ensure that the end product delivered by the MSI meets all the requirements specified in the RFP. The MSI shall take remedial action based on outcome of the tests.
- c. The MSI shall arrange for environments and tools for testing and for training as envisaged. Post Go-Live; the production environment should not be used for testing and training purpose. If any production data is used for testing, it should be masked and it should be protected. Detailed process in this regard including security requirement should be provided by the MSI in its technical proposal. The process will be finalized with the selected bidder.
- d. All the Third Party Auditors (TPA) as mentioned above will be appointed and paid by GWSCCL directly. All tools/environment required for testing shall be provided by the MSI.
- e. STQC/Other agencies appointed by GWSCCL shall perform the role of TPA. MSI needs to engage with the TPA at the requirement formulation stage itself. This is important so that unnecessary re-work is avoided and the audit is completed in time. The audit needs to be completed before Go-Live of different phases. MSI needs to prepare and provide all requisite information/documents to third party auditor and ensure that there is no delay in overall schedule.

- f. The cost of rectification of non-compliances shall be borne by the MSI.

4. Factory Testing

Success MSI shall have to submit Factory Test Certificate for the below mentioned materials before the actual supply of the items.

1. Cable
2. Pole
3. Signal Aspects

Authorized representative from GWSCCL will visit the manufacturing plant of the product subject to present in India. Authorized representative will check the testing process.

5. Final Acceptance Testing

The final acceptance shall cover 100% of the Warangal Project, after successful testing by the GWSCCL and Police Dept. or its PMU; a Final Acceptance Test Certificate (FAT) shall be issued by the GWSCCL and Police Dept. to the MSI.

Prerequisite for Carrying out FAT activity:

1. Detailed test plan shall be developed by the MSI and approved by GWSCCL. This shall be submitted by MSI before FAT activity to be carried out.
2. All documentation related to Warangal Project and relevant acceptance test document (including IT Components, Non IT Components etc.) should be completed & submitted before the final acceptance test to the GWSCCL and Traffic Police.
3. The training requirements as mentioned should be completed before the final acceptance test.
4. Successful hosting of Application, NMS and MIS Software.
5. For both IT & Non-IT equipment's / software manuals / brochures / Data Sheets / CD / DVD / media for all the Warangal Project supplied components.

The FAT shall include the following:

1. All hardware and software items must be installed at respective sites as per the specification.
2. Availability of all the defined services shall be verified.
3. The MSI shall be required to demonstrate all the features / facilities / functionalities as mentioned in the RFP.
4. The MSI shall arrange the test equipment required for performance verification, and will also provide documented test results.
5. The MSI shall be responsible for the security audit of the established system to be carried out by a certified third party as agreed by GWSCCL.

Any delay by the MSI in the Final Acceptance Testing shall render him liable to the imposition of appropriate Penalties. However, delays identified beyond the control of MSI shall be considered

appropriately and as per mutual agreement between GWSCCL and MSI. In the event the MSI is not able to complete the installation due to non-availability of bandwidth from the bandwidth service providers, the Supplier and GWSCCL may mutually agree to redefine the Network so the MSI can complete installation and conduct the Final Acceptance Test within the specified time.

5 Responsibility Matrix

#	Key Activities	Successful Bidder	GW MC	GWSC CL	Network Vendor/s	Electricity Provider/s	Other Utilities	Other Departments	PM C	Existing ICT Vendors at GWSCCL
Project Inception Phase										
1	Project Kick Off	R/A	C	C	C	I	I	I	C	I
2	Deployment of manpower	R/A	C	C	C	I	I	I	C	I
Requirement Phase										
3	Assess the requirement of IT Infrastructure and Non IT Infrastructure	R/A	C	C	C	C	C	C	C	C
4	Assessment of Business processes	R/A	C	C	C	I	I	C	C	I
5	Assessment of requirement of Software requirements	R/A	C	C	I	I	I	C	C	I
6	Assess the Integration requirement	R/A	C	C	C	C	I	C	C	C
7	Assess the connectivity requirement all locations (including Building)	R/A	C	C	C	I	I	C	C	I
8	Assessment the Network laying requirement	C	C	C	R/A	I	I	C	C	I
9	Assessment of training requirement	R/A	C	C	I	I	I	C	C	I
Design Phase										

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10	Formulation of Solution Architecture	R/A	C	C	C	I	I	C	C	I
11	Creation of Detail Drawing	R/A	C	C	C	I	I	C	C	I
12	Detailed Design of Smart City Solutions	R/A	C	C	C	I	I	C	C	I
13	Development of test cases (Unit, System Integration and User Acceptance)	R/A	C	C	C	I	I	C	C	I
14	Preparation of final bill of quantity and material	R/A	C	C	C	C	I	C	C	I
15	SoP preparation	R/A	C	C	C	C	C	C	C	I
Development Phase 1 & 2										
16	Helpdesk setup	R/A	C	C	I	I	I	I	C	I
17	Physical Infrastructure setup	R/A	C	C	I	I	I	I	C	I
18	Procurement of Equipment , edge devices, COTS software (if any), Licenses	R/A	C	C	I	I	I	I	C	I
19	IT and Non IT Infrastructure Installation	R/A	C	C	I	I	I	I	C	I
20	Development, Testing and Production environment setup	R/A	C	C	I	I	I	I	C	I
21	Software Application customization (if any)	R/A	C	C	I	I	I	I	C	I

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22	Development of Bespoke Solution (if any)	R/A	C	C	I	I	I	I	C	I
23	Data Migration	R/A	C	C	I	I	I	I	C	I
24	Integration with Third party services/application (if any)	R/A	C	C	I	I	I	I	C	I
25	Unit and User Acceptance Testing	R/A	C	C	I	I	I	I	C	I
26	Implementation of Solutions	R/A	C	C	I	I	I	I	C	I
27	Preparation of User Manuals , training curriculum and training materials	R/A	C	C	I	I	I	I	C	I
28	Role based training(s) on the Smart City Solutions	R/A	C	C	I	I	I	I	C	I
Integration Phase 1 & 2										
29	SoP implementation	R/A	C	C	C	C	C	C	C	I
30	Integration with GIS	R/A	C	C	C	C	C	C	C	I
31	Integration of solutions with Command and Control Centre	R/A	C	C	C	C	C	C	C	I
Go –Live Phase 1 & 2										
32	Go Live	R/A	C	C	I	I	I	I	C	I
Operation and Maintenance										
33	Operation and Maintenance of IT, Non IT infrastructure and Applications	R/A	C	C	I	I	I	I	C	I

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34	SLA and Performance Monitoring	R/A	C	C	I	I	I	I	C	I
35	Logging, tracking and resolution of issues.	R/A	C	C	I	I	I	I	C	I
36	Application enhancement	R/A	C	C	I	I	I	I	C	I
37	Patch & Version Updates	R/A	C	C	I	I	I	I	C	I
38	Helpdesk services	R/A	C	C	I	I	I	I	C	I

Note: All decisions will be taken by GWSCCL which will be abided by all the stakeholders in the above matrix.

R/A = Responsible/Accountable

C = Consulted

I = Informed

6 Project Deliverables

Bidder is expected to provide following list of minimum deliverables for the phases outlined in Section 7 and 8.

#	Key Activities	Minimum Deliverables	Phases as outlined in Section 2 (Project Timelines)	Timelines
1	Project Kick Off	1. Project Plan	Inception Phase	T + 30
2	Deployment of manpower	2. Risk Management & Mitigation Plan		
3	Assess the requirement of IT Infrastructure and Non IT Infrastructure	1. Functional Requirement Specification document 2. System Requirement Specification document		
4	Assessment of Business processes	3. Requirements Traceability Matrix		
5	Assessment of requirement of Software requirements	4. Site Survey Report		
6	Assess the Integration requirement			
7	Assess the connectivity requirement all locations (including Building)			
8	Assessment of network laying requirement			
9	Assessment of training requirement			
10	Formulation of Solution Architecture	1.Final BoQ 2.HLD documents	Requirement Gathering & Design Phase	T+60
11	Creation of Detail Drawing	3.LLD documents		
12	Detailed Design of Smart City Solutions	4. Application architecture documents.		
13	Development of test cases (Unit, System Integration and User Acceptance)	5. Technical Architecture documents. Network Architecture documents.		
14	Preparation of final bill of quantity and material	6. ER diagrams and other data modeling documents.		
15	SoP preparation	7. Logical and physical database design.		

		<p>8. Data dictionary and data definitions.</p> <p>9. GUI design (screen design, navigation, etc.).</p> <p>10. Test Plans</p> <p>11. SoPs</p> <p>12. Change management Plan</p>		
16	Helpdesk setup	<p>1. IT and Non IT Infrastructure Installation Report</p> <p>2. Completion of UAT and closure of observations report</p> <p>3. Training Completion report</p> <p>4. Application deployment and configuration report</p>	<p>Phase 1 and Phase 2 of Development, Testing and Go-Live of Smart City Components</p>	<p>T + 250</p>
17	Physical Infrastructure setup			
18	Procurement of Equipment , edge devices, COTS software (if any), Licenses			
19	IT and Non IT Infrastructure Installation			
20	Development, Testing and Production environment setup			
21	Software Application customization (if any)			
22	Development of Bespoke Solution (if any)			
23	Data Migration			
24	Integration with Third party services/application (if any)			
25	Unit and User Acceptance Testing			
26	Implementation of Solutions			
27	Preparation of User Manuals , training curriculum and training materials			
28	Role based training(s) on the Smart City Solutions			
29	SoP implementation	<p>1. Integration Testing Report</p>		
30	Integration with Smart Components			
31	Integration of solutions with Command and Control Centre			
32	Go Live	<p>1. Go-Live Report</p>		
33	Operation and Maintenance of IT, Non IT infrastructure and Applications	<p>1. Detailed plan for monitoring of SLAs and performance of the overall</p>		

34	SLA and Performance Monitoring	system		
35	Logging, tracking and resolution of issues.	2. Fortnightly Progress Report		
36	Application enhancement	3. Monthly SLA Monitoring Report and Exception		
37	Patch & Version Updates	Report		
38	Helpdesk services	4. Quarterly security Report 5. Issues logging and resolution report		

- The Bidder should submit project plan within one week of signing of contract.
- Final BoQ and its procurement plan should be submitted within a week of submitting the Project plan.
- Bidder should submit the specifications, compliance and datasheet before and after procurement of the materials and the same shall be duly verified by the authorities or any third party appointed by the authorities.
- Bidder should submit the make, model the item to be procured and there should be no deviations in the product quoted and the product procured. Any deviation should be duly brought to the notice of the Authorities and necessary approvals should be sought from Authorities before procurement.
- In case of any deviation in the procured material vis-à-vis the one proposed by the bidder, approvals from the authorities must be taken.
- Bidder/MSI to submit the Migration plan - should the state fiber be implemented during the duration of this contract - and implement the migration from existing network to Telangana Fiber Grid within one month.

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		3. Smart DC – non-IT equipment 4. Smart Disaster Recovery (DR)	
	CCTV Surveillance	25% camera to be installed across the city	
	Area Traffic Control System	25% of junctions to be covered in this phase	
	Intelligent Transit Management System	1. 25% of buses to be covered 2. 25% of Handheld Ticketing Devices to be implemented	
	Smart Parking Management System	1. 5 on-road parking locations to be implemented	
	UAT & Training		
	Integration of component with ICCC and Go-Live for Phase 1		T + 180 days
Development, Integration & Go-Live Phase 2 (Installation of HW/ Infrastructure, SW for Phase 2)	CCTV Surveillance	Rest of camera to be installed across the city	T + 220 Days
	Area Traffic Control System	Rest of junctions to be covered in this phase	
	Intelligent Transit Management System	1. Rest of buses to be covered 2. Other Municipal Vehicles, Fire Buses, Ambulances to be covered 3. Rest of Handheld Ticketing Devices to be implemented	
	Smart Parking Management System	Rest of parking locations to be covered	
	UAT & Training		
	Integration of component with ICCC and Go-Live for Phase 2		T + 250 Days

8 Annexure III: Payment Schedule and Milestones

8.1 Payment Phases

The payment schedule and milestones are divided into two broader phases which are again sub divided in further phases:

1. Implementation Phase

- a) Inception Phase
- b) Requirement Phase & Design Phase
- c) Development, Integration and Go-Live Phase 1
- d) Development, Integration and Go-Live Phase 2

2. Operation and Maintenance Phase

GWSCCL will take stock of the development on the regular basis and based on the implementation of one or more components, the payments will be made to the System Integrator. The Time Line for the implementation of the project (Based on which the payment will be made) is shown below:

Phase	Components	KPIs	Time
Inception Phase	<ul style="list-style-type: none"> • ICCC • DC & DR • CCTV Surveillance • Area Traffic Control System • Intelligent Transit Management System • Smart Parking Management • Environmental Sensors 	NA	T + 30 Days
Requirement Phase	<ul style="list-style-type: none"> • ICCC • DC & DR • CCTV Surveillance • Area Traffic Control System • Intelligent Transit Management System • Smart Parking Management • Environmental Sensors 	NA	T + 45 Days
Design Phase	<ul style="list-style-type: none"> • ICCC • DC & DR • CCTV Surveillance • Area Traffic Control System 	NA	T + 60 Days

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	<ul style="list-style-type: none"> Intelligent Transit Management System Smart Parking Management Environmental Sensors 		
Development, Integration & Go-Live Phase 1 (Installation of HW/ Infrastructure, SW for Phase 1)	ICCC	<ol style="list-style-type: none"> Command and Control Center (ICCC) IT hardware Command and Control Center (ICCC) non-IT equipment Command and Control Center (ICCC) – software Command and Control Center Viewing for (ICCC) IT hardware 	T + 150 Days
	DC & DR	<ol style="list-style-type: none"> Smart DC – Hardware Smart DC – Software Smart DC – non-IT equipment Smart Disaster Recovery (DR) 	
	CCTV Surveillance	25% camera to be installed across the city	
	Area Traffic Control System	25 % of junctions to be covered in this phase	
	Intelligent Transit Management System	<ol style="list-style-type: none"> 25% of buses to be covered 25% of Handheld Ticketing Devices to be implemented 	
	Smart Parking Management System	<ol style="list-style-type: none"> 2 on-road parking locations to be implemented 	
	UAT & Training		
	Integration of component with ICCC and Go-Live for Phase 1		T + 180 days
Development, Integration & Go-Live Phase 2 (Installation of HW/ Infrastructure, SW for Phase 2)	CCTV Surveillance	Rest of camera to be installed across the city	T + 220 Days
	Area Traffic Control System	Rest of junctions to be covered in this phase	
	Intelligent Transit Management System	<ol style="list-style-type: none"> Rest of buses to be covered Other Municipal Vehicles, Fire Buses, Ambulances to be covered Rest of Handheld Ticketing Devices to be implemented 	

	Smart Parking Management System	Rest of parking locations to be covered	
	UAT & Training		
	Integration of component with ICCC and Go-Live for Phase 2		T + 250 Days

8.2 Milestones and Payment Schedules for Implementation Phase

Based on findings of the site survey activity done by the MSI, the MSI may propose a change in the number of sites or individual units to be deployed in each phase as well as overall scope and a consequent change in phasing. GWSCCL also retains the right to suo-moto change the number of sites or individual units to be deployed for each scope item. The final decision on change in phasing and related change in payment schedules shall be at the discretion of GWSCCL.

MSI should complete all the activities within the defined timelines as indicated above. The timeline will be reviewed regularly during implementation phase and may be extended incase GWSCCL feels that extension in a particular Request Order/Integration or any track is imperative, for the reason beyond the control of the bidder. In all such cases GWSCCL's decision shall be final and binding. The MSI will be eligible for the payment based on the completion of activities and approval of the relevant deliverables.

Based on findings of the site survey activity done by the MSI, the MSI may propose a change in the number of sites or individual units to be deployed in each phase as well as overall scope and a consequent change in phasing. GWSCCL also retains the right to suo-moto change the number of sites or individual units to be deployed for each scope item. The final decision on change in phasing and related change in payment schedules shall be at the discretion of GWSCCL.

MSI should complete all the activities within the defined timelines as indicated above. The timeline will be reviewed regularly during implementation phase and may be extended in case GWSCCL feels that extension in a particular Request Order/Integration or any track is imperative, for the reason beyond the control of the bidder. In all such cases GWSCCL's decision shall be final and binding. The MSI will be eligible for the payment based on the completion of activities and approval of the relevant deliverables.

T = Effective Date of Contract Agreement

Payment Milestone	Phase	Time	Payment Terms
M1	Inception Phase	T + 30 Days	
M2	Requirement Phase and Design Phase	T + 60 Days	
M3	Upon Delivery of equipment / hardware / Capex Component	Monthly after M2	50 % of the quoted cost of the equipment / hardware / Capex Component, delivered that month, after due inspection and verification

M4	Delivery, Deployment and Commissioning Development, Integration and Go-Live Phase 1	T + 180 Days	25 % of the quoted cost of the equipment / hardware / Capex Component Installed, Commissioned, and integrated at Go-Live of Phase I
M5	Delivery, Deployment and Commissioning Development, Integration and Go-Live Phase 2	T + 250 Days	10 % of the quoted cost of the equipment / hardware / Capex Component Installed, Commissioned, and integrated at Go-Live of Phase 2

Note:

All payments to the Systems Integrator shall be made upon submission of invoices along with necessary approval certificates from concerned Authority like GWSCCL, GWMC.

The above payments are subject to meeting of SLA's failing which the appropriate deductions will be made as mentioned in the SLA document of this RFP.

For M3 Monthly payments 50 % of quoted cost of delivered capex items will be made upon due inspection and verification of the material (hardware components) during Phase 1 and Phase 2 post M2.

Bidder is required to obtain necessary approvals from Authority or relevant and authorized third party before and after procurement of material to ensure the quoted products in their bids match the procured products. Any changes in the products quoted vis-à-vis products ordered shall be duly brought to the notice of the authorities and procured only after due approvals.

The remaining payments for the respective phases shall be paid upon successful Go-Live during each phase.

8.3 Milestones and Payment Schedules for Operations and Maintenance Phase

The remaining 15% of the Capex Cost will be paid along with O&M Cost across 5 years in equated monthly payments

The Operations and maintenance phase will start as soon as Go-Live for the each phase occurs. The MSI will be required to adhere to the SLA and provide post implementations support of warranty and O&M for the remaining project period after implementation/Go-Live.

Milestones	Payment Milestones for the Implementation	Payment Schedule	Time Schedule
% Payment of Time Schedule Phase			
M6	Year 1 payment for O&M after Go-Live	Equal Monthly O&M Payments	Payment of Year 1
M7	Year 2 payment for O&M after Go-Live	Equal Monthly O&M Payments	Payment of Year 2

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M8	Year 3 payment for O&M after Go-Live	Equal Monthly O&M Payments	Payment of Year 3
M9	Year 4 payment for O&M after Go-Live	Equal Monthly O&M Payments	Payment of Year 4
M10	Year 5 payment for O&M after Go-Live	Equal Monthly O&M Payments	Payment of Year 5

Payment of Operations and maintenance phase will be made on monthly basis (at completion of each month) based on the adherence to SLA, for the amount quoted for each respective year.

9 Service Level Agreements

1. Service Level Agreement (SLA) shall become the part of contract between Authority and the successful bidder. SLA defines the terms of the successful bidder's responsibility in ensuring the timely delivery of the deliverables and the correctness of the same based on the agreed Performance Indicators as detailed in this section.
2. The successful bidder has to comply with service level requirements to ensure adherence to project timelines, quality and availability of services, throughout the period of this contract i.e. during implementation phase and for a period of five (5) years. The successful bidder has to supply appropriate software/hardware/ automated tools as may be required to monitor and submit reports of all the SLAs mentioned in this section.
3. For purposes of the SLA, the definitions and terms as specified in the document along with the following terms shall have the meanings set forth below:
 - "Total Time" - Total number of hours in the quarter (or the concerned period) being considered for evaluation of SLA performance.
 - "Uptime" – Time period for which the specified services/ outcomes are available in the period being considered for evaluation of SLA. Formulae for calculation of Uptime:
$$\text{Uptime (\%)} = \{1 - [(\text{Downtime}) / (\text{Total time} - \text{scheduled maintenance time})]\} * 100$$
 - "Downtime"- Time period for which the specified services/ components/ outcomes are not available in the concerned period, being considered for evaluation of SLA, which would exclude downtime owing to Force Majeure & Reasons beyond control of the successful bidder.
 - "Scheduled Maintenance Time" - Time period for which the specified services/ components with specified technical and service standards are not available due to scheduled maintenance activity. The successful bidder is required to take at least 10 days prior approval from Authority for any such activity. The scheduled maintenance should be carried out during non-peak hours (like post mid-night, and should not be for more than 4 hours. Such planned downtime would be granted max 4 times a year.
4. "Incident" - Any event / abnormalities in the service being rendered, that may lead to disruption in normal operations and services to the end user.
5. "Response Time" - Time elapsed from the moment an incident is reported in the Helpdesk over phone or by any applicable mode of communication, to the time when a resource is assigned for the resolution of the same.
6. "Resolution Time" - Time elapsed from the moment incident is reported to Helpdesk either in person or automatically through system, to the time by which the incident is resolved completely and services as promised are restored.

9.1 Pre-Implementation SLAs

1. These SLAs shall be used to evaluate the timelines for completion of deliverables that are listed in the deliverable.
2. These SLAs for completion of individual milestones listed in the implementation schedule. For delay of every week in completion & submission of the deliverable mentioned in the section of deliverables & timeline e, the selected bidder would be charged with a penalty as follows:

Delay (Weeks)	Penalty (INR)
1 week of delay for completion of scope for any smart element	0.1% of capex of respective smart element value
For every subsequent week	0.15% of capex of respective smart element value

3. In case the penalties for the selected bidder reaches 10% of the capex value in the form of penalty, cumulative of penalties for all smart elements, at any point of time during the duration of pre-implementation phase, GMVC reserves the right to invoke the termination clause.

9.2 Post-Implementation SLAs

1. These SLAs shall be used to evaluate the performance of the services on monthly basis.
2. Penalty levied for non- performance as per SLA requirements shall be deducted through subsequent payments due from Authority or through the Performance Bank Guarantee.
3. The SLA parameters shall be measured for each of the sub systems' SLA parameter requirements and measurement methods, through appropriate SLA Measurement tools. All such required tools should be provided by the successful bidder. GWMC will have the authority to audit these tools for accuracy and reliability.
4. The upper limit of penalty would be capped at 10% of the opex value for each month. In case the calculated penalty crosses 10% penalty of the opex value in a quarter, GWMC reserves the right to invoke the termination clause.
5. **SLAs for street IT infrastructure such as surveillance cameras, RLVD cameras, ANPR cameras, emergency call box, public address system, and digital display boards and parking systems**

#	Uptime SLA (Monthly)	Penalty Clause
1	Uptime \geq 99.5%	No Deduction
2	Uptime $<$ 99.5%	(99.5%- Uptime %) of monthly Operational Expense for the component. For example if uptime of component is 95%, then penalty imposed will be 99%-95% i.e. 4% of operational expense.

6. Uptime definition: All devices have to be working and deliver the desired results. The no. of hours that the particular device/ equipment does not work will be treated as down time. Uptime shall be calculated as $Uptime (\%) = \{1 - [(Downtime) / (Total\ time - \text{scheduled maintenance time})]\} * 100$. For ex, if 10 nos. of Sensors for Digital display are deployed at various locations, and 2 device/ units does not work for 5 Hrs, the total non-working device hours will be 10 unit hours (and the uptime would be $\{1 - (10 / (10 * 90 * 24))\}$, 10 being the number of units, for 90 days on 24 hours basis.
7. The penalties would be levied for every unit down time hour.

8. SLA and Penalty for Helpdesk Response and Resolution time

#	Parameter	Penalty Clause
1	For <= 1% of the calls not getting responded in less than or equal to 60 seconds per quarter	No Deduction
2	For > 1% of the calls not getting responded in less than or equal to 60 seconds per quarter	0.5% of the monthly opex value

9. SLA for Change Requests or enhancements

#	Parameter	Metric	Frequency	Penalty
1	Criticality of Change – Low	< T, where T is the timeframe for completion of the Change request as agreed upon by Authority and successful bidder	Weekly per Occurrence	1 % of change request value per week for the first two weeks for each occurrence, 2 % of change request value per week for every subsequent week, subject to a maximum of 10% post which Authority may invoke annulment of the contract.
2	Criticality of Change – Medium	< T, where T is the timeframe for completion of the Change request as agreed upon by Authority and successful bidder	Weekly per Occurrence	1.5 % of change request value per week for the first two weeks for each occurrence, 2.5 % of change request value per week for every subsequent week, subject to a maximum of 10% post which Authority may invoke annulment of the contract.

3	Criticality of Change – High	< T weeks, where T is the timeframe for completion of the Change request as agreed upon by Authority and successful bidder	Weekly per Occurrence	2 % of change request value per week for the first two weeks for each occurrence, 3 % of change request value per week for every subsequent week, subject to a maximum of 10% post which Authority may invoke annulment of the contract.
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10. SLA for issue resolution

#	Parameter	Metric	Frequency	Penalty
1	Severity 1 Issue	Resolution Time: ≤ 8 Hrs from the time the call is logged by end user.	Daily	0.1% of monthly opex value per week for the first two weeks for each occurrence, 0.2% of monthly opex value per week for every subsequent week, subject to a maximum of 10% post which Authority may invoke annulment of the contract.
2	Severity 2 Issue	Resolution Time: ≤ 4 Days from the time the call is logged by end user.	Daily	0.1% of monthly opex value per week for the first two weeks for each occurrence, 0.2% of monthly opex value per week for every subsequent week, subject to a maximum of 10% post which Authority may invoke annulment of the contract.
3	Severity 3 Issue	Resolution Time: ≤ 10 Days from the time the call is logged by end user.	Daily	0.1% of monthly opex value per week for the first two weeks for each occurrence, 0.2% of monthly opex value per week for every subsequent week, subject to a maximum of 10% post which Authority may invoke annulment of the contract.

4	Severity 4 Issue	Resolution Time: ≤ 20 Days from the time the call is logged by end user.	Daily	0.1% of monthly opex value per week for the first two weeks for each occurrence, 0.2% of monthly opex value per week for every subsequent week, subject to a maximum of 10% post which Authority may invoke annulment of the contract.
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11. Miscellaneous SLAs

#	Parameter	Metric	Frequency	Penalty
1	Compliance in document versioning and maintenance (FRS, SRS, Business Blue Prints, User Training Manual etc.), application version control, updates & patches etc.	100% as per requirement timelines	Daily per occurrence	Rs.10,000 per occurrence per day of delay.
2	Manpower Availability & Readiness	100% as per requirement timelines	Daily	Rs 10,000 per day in case there is shortage in manpower deployment or lack of adequate skills
3	Scheduled downtime for System Maintenance per week	≤ 2 times per month	Per Occurrence	Rs. 1,00,000 per occurrence for unscheduled downtime or scheduled downtimes exceeding the specified metric.

4	Resource Replacement	Within 7 days of exit of resource (in case of Authority initiated or supplier initiated)	Per Occurrence	Rs. 5,000.00 per day of unavailability of resource
5	Application Security	Cyber Crime / Hacking / Data Theft / Fraud attributable to the service provider	Per Occurrence	Depending on the type of incident and its impact, a Penalty of 10 Lakhs or in case of severe issue (as defined by Authority) such breach may lead to termination of contract

Definitions:

- Severity 1: Command and Communication Center or Smart City applications down for more than 70% users.
- Severity 2: Command and Communication Center or Smart City applications down for more than 30% users.
- Severity 3: Modules of Command and Communication Center not functional for users.
- Severity 4: Minor functionality issues with Command and Communication Center or Smart City applications
- Response Time: Response time is defined as the time the support vendor takes to respond from the time that ticket was raised.
- Resolution Time: Resolution time is defined as the time the vendor takes to resolve the issue or provide acceptable workaround for the issue.

9.3 Conditions for No Penalties

Penalties shall not be levied on the Bidder in the following cases:

- There is a force majeure event effecting the SLA which is beyond the control of the successful bidder. Force Majeure events shall be considered in line with the clause mentioned RFP.
- The non-compliance to the SLA has been due to reasons beyond the control of the successful bidder.
- Theft cases by default/ vandalism would not be considered as “beyond the control of bidder”. Hence, the Bidder should be taking adequate anti-theft measures, spares strategy, Insurance as required to maintain the desired Required SLA.

10 Annexure IV: Smart City-Design Consideration

10.1 Key Design Considerations

Key design considerations taken into account are as follows –

- Designed for 24x7 online availability of application.
- Scalable solution on open protocols
- No propriety devices/ applications
- API based architecture for Integration with other web applications and Mobile applications

The key guiding principles considered for building the integrated solution are the following:

1. **Continuous adoption of rapidly evolving Technology** - Technology evolves too fast and Government projects similar to Smart City with its long procurement cycles do not align naturally to adapt to this trend. Also, any changes to existing implementations require contract changes, new RFP (Request for Proposal), etc. Hence the entire system would be built to be open (standards, open API, plug-n-play capabilities), components coupled loosely to allow changes in sub-system level without affecting other parts, architected to work completely within a heterogeneous compute, storage, and multi-vendor environment.
2. **Selection of best solution at best rate as and when required** - Large integrated systems of Smart City operations should be designed to get best cost and performance advantages of natural technology curve (constant increase of speed and decrease of cost) and still aligned to open procurement practices of the Government. For this to happen, architecture should be open and vendor neutral, use commodity hardware, and designed – for horizontal scale. This allows buying of commodity compute, storage, etc. only when needed at best price.
3. **Distributed Access and Multi-channel service delivery** -With high penetration of mobile devices and very large percentage of internet usage using mobile devices, it is imperative that the Smart City applications provide multiple channels of service delivery to its stakeholders. An important consideration is that the access devices and their screen capabilities (including browser variations) are numerous and constantly evolve. Hence, it is imperative to design the system such that the ecosystem of Smart City-integrated mobile apps also evolves.
4. **Security and privacy of data** - Security and privacy of data within the integrated Project will be foundational keeping in view of the sensitivity of data and critical nature of the infrastructure envisioned to be built for Smart City operations. Security and privacy of data should be fundamental in design of the system without sacrificing utility of the system. When creating a system of this scale, it is imperative that handling of the sensitivity and criticality of data are not afterthoughts, but designed into the strategy of the system from day one.
5. **Provision of a Sustainable, Scalable Solution**- The motive of the technological enhancements to provide a system that would be sustainable for the next few years. The expectation is that the system should sustain at least 5 years from GO-Live. The solution would be done keeping in mind

the scalability of the system. The simplified procurement processes and ease of compliance is expected to lead to huge growth in contract's base. Every component of GWSCCL system needs to scale horizontally to very large volume of data.

The Application Software will have the capability to scale up to tomorrow's requirements like given below:

1. Managing the entire Property Life Cycle (Data Collaboration between various govt. departmental systems)
2. Maintaining Information on Citizen Life Cycle (Right from Birth to Marriage, Health, Education, Driving License, Interactions with GWSCCL)
3. **API Approach-** GWSCCL has decided to adopt Open API as the guiding paradigm to achieve the above goals. Though GWSCCL system would develop a portal but that would not be the only way for interacting with the GWSCCL system as the stakeholders via his choice of third party applications, which will provide all user interfaces and convenience via desktop, mobile, other interfaces, will be able to interact with the GWSCCL system. These applications will connect with the GWSCCL system via secure GWSCCL system APIs. This architectural approach has been taken as the UI based integration through a ubiquitous web portal requires manual interaction and does not fit most consumption scenarios. The following benefits are envisaged from API based integration,
 - Consumption across technologies and platforms(mobile, tablets, desktops, etc.) based on the individual requirements
 - Automated upload and download of data
 - Ability to adapt to changing taxation and other business rules and end user usage models
 - Integration with customer software (GIS, Accounting systems).
4. **Business Rule Driven Approach-** All configurations including policy decisions, business parameters, rules, etc. shall be captured in a central place within the system. The system shall provide facility to the decision makers to add new or edit/delete existing policies or make changes with appropriate permission control and audit trace. Managing these in a central repository ensures only once source of truth is used across many application servers and reduces issues of inconsistent application behaviour. Decoupling of the business parameters/rules/master data from the rest of the solution architecture and making them configurable allows for a great deal of flexibility.
5. **Data Distribution Service-** As a future roadmap it is envisaged that the functionalities provided by the GWSCCL Project should be available as services that could be offered to other stakeholders on request. Keeping this in mind the system shall be able to provide data on subscription-publication basis. The organization of the information exchange between modules is fundamental to publish-subscribe (PS) systems. The PS model connects anonymous information producers (publishers) with information consumers (subscribers). The overall distributed application (the PS system) is composed of processes. The goal of the DDS architecture is to facilitate efficient distribution of data in a distributed system. Participant using DDS can 'read' or

‘write’ data efficiently and naturally with a typed interface. Underneath, the DDS middleware will distribute the data so that each reading participant can access the ‘most current’ values.

10.2 Guiding Architecture Principle

The IT architecture principles defined in this section are the underlying general rules and guidelines that will drive the subsequent development, use and maintenance of architectural standards, frameworks and future state target architecture.

GWSCCL system will be built on the following core principles:

1. Platform Approach

It is critical that a platform based approach is taken for any large scale application development, to ensure adequate focus and resources on issues related to scalability, security and data management. Building an application platform with reusable components or frameworks across the application suite provides a mechanism to abstract all necessary common features into a single layer. Hence the GWSCCL system is envisaged as a faceless system with 100% API driven architecture at the core of it. GWSCCL portal will be one such application on top of these APIs, rather than being fused into the platform as a monolithic system.

Open APIs designed to be used form the core design mechanism to ensure openness, multi-user ecosystem, specific vendor/system independence, and most importantly providing tax payers and other ecosystem players with choice of using innovative applications on various devices (mobile, tablet, etc.) that are built on top of these APIs.

2. Openness

Adoption of open API, open standards and wherever prudent open source products are of paramount importance for the system. This will ensure the system to be lightweight, scalable and secure. Openness comes from use of open standards and creating vendor neutral APIs and interfaces for all components. All the APIs will be stateless. Data access must be always through APIs, no application will access data directly from the storage layer or data access layer. For every internal data access also (access between various modules) there will be APIs and no direct access will be there.

3. Data as an enterprise asset

Information is a high value asset to be leveraged across the organization to improve performance and decision making. Accurate information would ensure effective decision making and improved performance

Effective and careful data management is of high importance and top priority should be placed on ensuring where data resides, that its accuracy can be relied upon, and it can be obtained when and where needed.

4. Performance

A best of breed solution using the leading technologies of the domain should be proposed in the solution ensuring the highest levels of performance. It will also ensure that the performance of various modules

should be independent of each other to enhance the overall performance and also in case of disaster, performance of one module should not impact the performance other modules.

The solution should be designed in a manner that the following can be achieved:

- Modular design to distribute the appropriate system functions on web and app server
- Increase in-memory Operations (use static operations)
- Reduce number of I/O operations and N/w calls using selective caching
- Dedicated schemas for each function making them independent and avoiding delays due to other function accessing the same schema.
- Solution should provide measurable and acceptable performance requirements for users, for different connectivity bandwidths.
- The solution should provide optimal and high performance Portal Solution satisfying response time for slow Internet connections and different browsers.

5. Scalability

The component in the architecture will be capable of being scaled up to more user requests or handling more no. of input resources in various modules. Even inclusion of additional application functionalities can be catered to by upgrading the software editions with minimal effort.

The design of the system to consider future proofing the systems for volume handling requirements

- The application functions to be divided logically and developed as Modular solution.
- The system should be able to scale horizontally & vertically.
- **Data Volume**- Ability to support at least 20 % projected volume growth (year on year) in content post system implementation & content migration.
- **Functionality** – Ability to extend functionality of the solution without significant impact to the existing functional components and infrastructure.
- **Loose coupling through layered modular design and messaging** - The architecture would promote modular design and layered approach with clear division of responsibility and separation of concerns at the data storage, service and integration layer in order to achieve desired interoperability without any affinity to platforms, programming languages and network technologies. The architecture has to be scalable, maintainable and flexible for modular expansion as more citizen and business services are provided through the Project. Each of the logical layers would be loosely coupled with its adjacent layers
- **Data partitioning and parallel processing** - Project functionality naturally lends itself for massive parallel and distributed system. For linear scaling, it is essential that entire system is architected to work in parallel within and across machines with appropriate data and system partitioning. Choice of appropriate data sources such as RDBMS, Hadoop, NoSQL data stores, distributed file systems; etc. must be made to ensure there is absolutely no “single point of

bottleneck” in the entire system including at the database and system level to scale linearly using commodity hardware.

- **Horizontal scale for compute, Network and storage** – Project architecture must be such that all components including compute, network and storage must scale horizontally to ensure that additional resources (compute, storage, network etc.) can be added as and when needed to achieve required scale.

6. No Vendor lock-in and Replace-ability

Specific OEM products may only be used when necessary to achieve scale, performance and reliability. Every such OEM component/service/product/framework/SI pre-existing product or work must be wrapped in a vendor neutral API so that at any time the OEM product can be replaced without affecting rest of the system. In addition, there must be at least 2 independent OEM products available using same standard before it can be used to ensure system is not locked in to single vendor implementation.

7. Security

The security services will cover the user profile management, authentication and authorization aspects of security control. This service run across all the layers since service components from different layers will interact with the security components. All public contents should be made available to all users without authentication. The service will authenticate users and allows access to other features of the envisaged application for which the user is entitled to.

The system should be designed to provide the appropriate security levels commiserate with the domain of operation. Also the system will ensure data confidentiality and data integrity.

The application system should have the following

- A secure solution should be provided at the hardware infrastructure level, software level, and access level.
- Authentication, Authorization & Access Control: 3 factors (User ID & Password, Biometric, and Digital Signature) security mechanisms should be implemented to enable secure login and authorized access to portal information and services.
- Encryption Confidentiality of sensitive information and data of users and portal information should be ensured.
- Appropriate mechanisms, protocols, and algorithms necessary to protect sensitive and confirmation data and information both during communication and storage should be implemented.
- Data security policies and standards to be developed and adopted across the Smart City departments and systems
- In order to adequately provide access to secured information, security needs must be identified and developed at the data level. Database design must consider and incorporate data integrity requirements.

- Role based access for all the stake holders envisaged to access and use the system
- Appropriate authentication mechanism adhering to industry good practice of Password Policies etc.
- Ability to adopt other authentication mechanism such as Electronic Signature Certificates
- Authorization validity to be ensured for the users providing the Data to the system. Data should be accepted only from the entity authorized
- Data should be visible only to the authorized entity
- Audit trails and Audit logging mechanism to be built in the system to ensure that user action can be established and can investigated if any can be aided(e.g. Logging of IP Address etc.)
- Data alterations etc. through unauthorized channel should be prevented.
- Industry good practice for coding of application so as to ensure sustenance to the Application Vulnerability Assessment

System must implement various measures to achieve this including mechanisms to ensure security of procurement data, spanning from strong end-to-end encryption of sensitive data, use of strong PKI national standards encryption, use of HSM (Hardware Security Module) appliances, physical security, access control, network security, stringent audit mechanism, 24x7 monitoring, and measures such as data partitioning and data encryption.

Activities such as anti-spoofing (no one should be able to masquerade for inappropriate access), anti-sniffing (no one should be able get data and interpret it), anti-tampering (no one should be able to put/change data which was not meant to be put/changed) should be taken care for data in transit, as well as data at rest, from internal and external threats.

8. User Interface

The architecture and application solutions to be designed should promote simplicity and ease of use to the end users while still meeting business requirements. It should provide a simpler and more cost-effective solution. Reduces development time and makes the solution easier to maintain when changes in requirements occur.

This will be accomplished by the implementation of rich User Interfaces along with its integration with the DMS, Relational Data Store, Messaging and other external applications.

- Efficient and layout design are the key considerations that enhance usability which should be factored in while designing the application. Standard and consistent usability criteria must be defined. An intuitive, user friendly, well-articulated navigation method for the applications greatly enhances the usability of the application.
- Effective information dissemination
- Enhanced functionalities including personalized delivery of content, collaboration and enriching GUI features

- The load time for all web page user interfaces must satisfy both the following response time targets on 1 mbps connection:
 - 3 sec for welcome page
 - 5 sec for static pages
 - 10 sec for dynamic pages
- Ability to perform a simple search within 10 seconds on 1 mbps connectivity and a complex search (combining four terms) within 15 seconds regardless of the storage capacity or number of files and records on the system.
- Mobile Application Platform
 - Applications and services including all appropriate channels such as SMS/USSD/IVRS and development of corresponding mobile applications to the applications and services leveraging the Mobile Service Delivery Gateway (MSDG) and Mobile App Store.
 - Application platform should support the following smart phone mobile OS (Android 4.0 and above, iOS 4, 5 and above, Windows Phone OS 8.0 and above, Mobile Web App)
 - Support the target packaging components like (Mobile Website, Hybrid App, Native App, Web App and Application Development, Eclipse tooling platforms)
 - Support the ability to write code once and deploy on multiple mobile operating systems
 - Support integration with native device API
 - Support utilization of all native device features
 - Support development of applications in a common programming language
 - Support integration with mobile vendor SDKs for app development and testing
 - Support HTML5, CSS3, JS features for smartphone devices
 - Support common protocol adapters for connection to back office systems (i.e. HTTP, HTTPS, SOAP, XML for format)
 - Support JSON to XML or provide XHTML message transformations
 - Support multi-lingual and language internalization
 - Support encrypted messaging between server and client components

9. Reliability

This is a very crucial system and data are of high sensitivity, the data transfer and data management should be reliable to keep the confidence of the stakeholders. The system should have appropriate measures to ensure processing reliability for the data received or accessed through the application.

It may be necessary to mainly ensure the following

- Prevent processing of duplicate incoming files/data
- Unauthorized alteration to the Data uploaded in the GWSCCL system should be prevented
- Ensure minimum data loss(expected zero data loss)

10. Manageability

It is essential that the application architecture handles different failures properly; be it a hardware failure, network outage, or software crashes. The system must be resilient to failures and have the ability to restart, and make human intervention minimal.

All layers of the system such as application, infrastructure must be managed through automation and proactive alerting rather than using 100's of people manually managing.

The entire application must be architected in such a way that every component of the system is monitored in a non-intrusive fashion (without affecting the performance or functionality of that component) and business metrics are published in a near real-time fashion. This allows data centre operators to be alerted proactively in the event of system issues and highlight these issues on a Network Operations Centre (NoC) at a granular level. The solution should be envisaged to utilize various tools and technologies for management and monitoring services. There should be management and monitoring tools to maintain the SLAs.

11. Availability

The solution design and deployment architecture will ensure that the application can be deployed in a centralized environment offering system High Availability and failover.

The solution should meet the following availability requirements

- Load Balanced across two or more Web Server avoiding single point of failure
- Deployment of multiple application instances should be possible
- Distributed or load balanced implementation of application to ensure that availability of services is not compromised at any failure instance.
- Network, DC, DR should be available 99.99 % time.

12. SLA driven solution

Data from connected smart devices to be readily available (real-time), aggregated, classified and stored, so as not to delay the business processes of monitoring and decision making, and will enable appropriate timely sharing across the Smart City organization.

Readily available and consumed device data will facilitate timely access of analytics reports at every level and department of the Smart City and provide timely analysis of data as well as monitoring of KPIs through SLAs resulting in effective service delivery and improved decision making.

13. Reconstruction of truth

System should not allow database/system administrators to make any changes to data. It should ensure that the data and file (data at rest) that is kept in the systems has tamper resistance capacity and source of truth (original data of invoices and final returns) could be used to reconstruct derived data such as ledgers and system generated returns. System should be able to detect any data tampering through matching of hash value and should be able to reconstruct the truth.

- Services/solutions should be flexible and extensible to respond to, accommodate and adapt to changing business needs and unanticipated requirements easily. Consolidate and simplify technology applications wherever possible to minimize complexity. Ongoing application, database and server consolidation may be required.
- Software should use meta-data to configure itself (using declarations rather than coding).
- Avoid proprietary solutions and technologies if possible. Consider adhering to latest industry best practices and technical standards.
- The infrastructure should support an environment that allows applications to start small, grow quickly, and operate inexpensively. An adaptable infrastructure provides the capability to add to the current infrastructure with minimum inconvenience to the user.
- The IT architecture should be designed to support the overall SLA requirements around scalability, availability and performance.
- Each application should be performance tested to identify performance issues. The potential performance bottlenecks need to be identified and cost-effective paths for performance improvements should be provided for these identified problem areas.
- The system infrastructure should be architected considering failover requirements and should ensure that a single server or network link failure does not bring down the entire system.
- The system should be reliable handling every request and yield a response. It should handle error and exception conditions effectively

14. Integration Architecture

This section recommends the proposed integration architecture aligning with the overarching architectural principles.

The following are the integration specifications for the various integration scenarios -

- **Real-time integration**

All the Smart City applications will be deployed in the Data Centre while any external application of the Smart City ecosystem will reside in outside premises.

The need for an **OPC Unified Architecture (OPC- UA)** is felt that will facilitate GWSCCL in defining an enterprise integration platform. An OPC platform will help in data exchange across applications in real-time mode (both synchronous and asynchronous), promote loose coupling with ease of maintenance and change, facilitate rapid composition of complex services, achieve scalability through modularity, and improved business visibility.

The OPC UA architecture is a service-oriented architecture (SOA) and is based on different logical levels. It is an architectural style that allows the integration of heterogeneous applications & users into flexible service delivery architecture. Discrete business functions contained in enterprise applications could be organized as layers of interoperable, standards-based shared "services" that can be combined, reused, discovered and leveraged by other applications and processes.

The following are the various integration modes and techniques that could be leveraged –

- OPC Base Services are abstract method descriptions, which are protocol independent and provide the basis for OPC UA functionality. The transport layer puts these methods into a protocol, which means it serializes/deserializes the data and transmits it over the network. Two [protocols](#) are specified for this purpose. One is a binary [TCP](#) protocol, optimized for high performance and the second is [Web service](#)-oriented
- SOAP web service based interfacing technique will be leveraged as the real-time point to point synchronous integration mode with external or third party systems. The following integration points could be considered for SOAP web service based interfacing -
 - Payment gateway of the authorized banks to enable authorized users make financial transactions for the Smart City services availed by them. This should support a unified interface to integrate with all Payment Service Providers using web services over secured protocols.
 - SMS application, acting as the SMS Gateway, will make use of APIs for SMS communication to GSM network using the GSM modem, which can be both event-driven as well as time-driven. The API will be exposed to initiate the broadcasting or alert notification.
 - Social Media Apps and NoSQL data stores to exchange photos, videos and message feeds, based on interactions with Citizens and Business as well as comments/posts to inform stakeholders
 - IVR/Customer Support solution with ERP and Transactional Data Repository to exchange citizen and business demographic, registration and payment data as well as transactional data related to citizen services and municipal operations.
- Message based interfacing technique will be leveraged for real-time asynchronous integration mode. The following integration points could be considered for message based interfacing -
 - Central LDAP with ERP to synchronize member and employee user registration data
 - Payment solution and ERP to exchange payment data for tracking of beneficiary's payment transactions against different services (citizen, workers, transporter, vendor), master data (employee, vendor/supplier, location, facilities, price table)
 - Employee attendance data with ERP (HR Module) to capture data pertaining to employee location and attendance
 - Departmental applications with ERP (Asset Management module) to exchange data for procurement and maintenance of any assets or infrastructure items for each department.
 - Municipal operations application with ERP (Material Management module) to capture materials related transaction and inventory data for public works
 - Other government applications with Smart City application to exchange data for government procurement, public health schemes, welfare schemes, citizen health, etc.
- RESTful API service based interfacing technique will be leveraged for the following integration areas-

- Access and use of various services provided by the different departments for citizens and business community will be done through a RESTful, stateless API layer.
- Access and use of various internal functions related to operations and administration of Smart City for departmental and GWSCCL employees will be done through a RESTful, stateless API layer
- Data integration in batch mode will be through ETL. The following integration points could be considered for ETL based data integration -
 - Initial data migration to cleanse, validate and load the data extracted from source systems into target tables
 - Data load from all the individual transactional systems like ERP, Grievance Redressal to central enterprise data warehouse solution for aggregation, mining, dashboard reporting and analytics.

Process Integration layer of the GWSCCL solution will automate complex business processes or provide unified access to information that is scattered across many systems. Process Integration will provide a clean separation between the definition of the process in the process model, the execution of the process in the process manager, and the implementation of the individual functions in the applications. This separation will allow the application functions to be reused in many different processes.

An enterprise service bus (ESB) is a software architecture model used for designing and implementing the interaction and communication between mutually interacting software applications in Service Oriented Architecture. As software architecture model for distributed computing it is a variant of the more general client server software architecture model and promotes strictly asynchronous message oriented design for communication and interaction between applications. Its primary use is in Enterprise Application Integration of heterogeneous and complex landscapes. Following are the requirement for an ESB system:

- The solution should support static/deterministic routing, content-based routing, rules-based routing, and policy-based routing, as applicable in various business cases.
- The solution should have capabilities to receive input message in heterogeneous formats from various different systems, interpret those messages, process and transform those messages to generate output and feed them to various different clients as per formats applicable.
 - The solution should have features to communicate across different services, process them and expose as single aggregate service to facilitate business functionality
 - ESB should support SOA standards such as XML, XSLT, BPEL, web services standards and messaging standards.
 - ESB should support all industry standards interfaces for interoperability between different systems

There are four integration gateways envisaged as part of the solution design. The key requirements with respect to each of these are mentioned below:

SMS Gateway: SMS services are envisaged to be made available as part of the solution design. The service provider may integrate the solution with MSDG, and use the services available through it, or deploy its own

SMS Gateway services at no extra charge to GWSCCL, but it is a mandatory requirement that all the SMS based services (alerts and notifications) should be available as part of the solution. Following are some of the key requirements for the SMS services through the solution:

- Should contain required details/information and targeted to the applicant or designated officers of tax departments and other stakeholders and users as per prevailing TRAI norms
- Facilitate access through access codes for different types of services
- Support automated alerts that allows to set up triggers that will automatically send out reminders
- Provide provision for International SMS
- Provide provision to receive messages directly from users
- Provide provision for personalized priority messages
- Resend the SMS in case of failure of the message
- Provide messaging templates

Email Services: Email services are envisaged to be made available as part of the solution design to send alerts/intimations/automated messages to registered email ids, based on preferences set up/opted by individual users. An authenticated SMTP mail service (also known as a SMTP relay or smart host) is envisaged to be integrated with the solution for sending mail from the solution, and delivered to intended inbox. Support antispam features.

Payment Gateway: The solution is envisaged to have integration with payment gateways, to enable authorized Users make financial transactions, as per rights and privileges provided to him/her. The service provider is required to make the provisions for integration with such third party gateways and provide payment services, as per requirement of the GWSCCL. Some of the key features of payment gateway are mentioned below:

- Should support secure integration with Payment Service Providers
- Should support a unified interface to integrate with all Payment Service Providers
- Should support integration with Payment Service Providers using web services and over HTTP/S protocol
- Should manage messages exchange between UI and payment service providers
- Should support beneficiary's payment transactions tracking against various services
- Should support bank accounts reconciliation
- Should provide logs for all transactions performed through the Payment Gateway for future financial dispute resolution that might arise between entities and either beneficiaries or Payment Service Providers
- Should maintain and keep transactions logs for time period required and specified by the financial regulations followed in country

- Should support redundant Payment Discovery
- Should submit Periodic Reconciliation Report to government entities
- Should support transaction reports to monitor and track payments
- Should support real-time online credit card authorization for merchants
- Should support compliance with emerging trends and multiple payment options such debit card, credit card, cash cards and other payment gateways
- Should provide fraud screening features
- Should support browser based remote administration
- Should support multicurrency processing and settlement directly to merchant account
- Should support processing of one-time or recurring transactions using tokenization
- Should support real time integration with SMS and emails

IVR Services: IVR services are envisaged as part of Call Centre facility, which will be integrated with the solution, to provide information and services to the people who would contact the Call Centre: Some of the key features of the IVR services are mentioned below:

- Should provide multi-lingual content support
- Should facilitate access through access codes for different types of services
- Should support Web Service Integration
- Should support Dual Tone Multi Frequency (DTMF) using telephone touchpad - in-band and out-of-band
- Should support for Voice Extensible Markup Language (VoiceXML)
- Should support speech recognition that interprets spoken words as texts (Advanced Speech Recognition).
- Should support playing of pre-recorded sounds
- Should support redirection to human assistance, as per defined rules
- Should be able to generate Data Records – (CDRs) and have exporting capabilities to other systems
- Should provide provision for voice mailbox and voice recognition

There are multiple ways of integration of the solution with other systems is envisaged. These may be through Web Services, Message Queuing, File based or API based. The integration and data sharing mechanism may be either in Batch Mode or Needs basis (synchronous or asynchronous). Some of the key requirements of the interface/integration are mentioned below:

- Interface Definition
- Interface Owner

- Interface Type
 - Interface Format
 - Frequency
 - Source System
 - API/Service/Store Procedure
 - Entitlement Service
 - Consuming System
 - Interface Layout (or) Schema
- Should have provision for exceptional scenarios
 - Should have syntax details such as data type, length, mandatory/option, default values, range values etc.
 - Error code should be defined for every validation or business rule
 - Inputs and outputs should be defined
 - Should be backward compatible to earlier datasets
 - Data exchange should provide transactional assurance
 - Response time and performance characteristics should be defined for data exchange
 - The failover scenarios should be identified
 - Data exchange should be auditable

Note: Bidder is free to proposed their own design to be meet the scope and SLA requirement

10.3 Security

Data exchange should abide by all laws on privacy and data protection Security Architecture

This section recommends the proposed security architecture aligning with the overarching architectural principles. The basic tenets of Smart City security architecture are the design controls that protect confidentiality, integrity and availability of information and services for all the stakeholders.

10.4 User Security and Monitoring

1. Authentication & Authorization

A strong authentication mechanism should be considered to protect unauthorized access to the Smart City applications. Consider use of at least two of the following forms of authentication mechanism:

- Something you know, such as a password, PIN etc.
- Something you have, such as a smart card, hardware security token etc.
- Something you are, such as a fingerprint, a retinal scan, or other biometric methods

2. Levels of Authentication

Based on the security requirements the following levels of authentication should be evaluated.

- For applications handling sensitive data it is recommended that in the least one factor authentication key in the form of a password is essential. Strong password complexity rules should be enforced to ensure confidentiality and integrity of the data
- For applications handling highly sensitive data it is recommended that two factor authentication mechanisms should be considered. The first line of defence is the password conforming to the password complexity rules'. Along with the password next user has to provide a one-time password which varies for each session. One time passwords are valid for each session and it is not vulnerable to dictionary, phishing, interception and lots of other attacks. A counter synchronized One-Time Password (OTP) solution could be used for this purpose.

3. Authorization

Authorization of system users should be enforced by access controls. It is recommended to develop access control lists. Consider the following approach for developing access control list -

- Establish groups of users based on similar functions and similar access privilege.
- Identify the owner of each group
- Establish the degree of access to be provided to each group

10.5 Data Security

1. Traditional Structured Enterprise Data

GWSCCL should protect Integrated Project information against unauthorized access, denial of service, and both intentional and accidental modification. Data security, audit controls and integrity must be ensured across the data life cycle management from creation, accessed, viewed, updated and when deleted (or inactivated). This provides a proactive way to build defences against possible security vulnerabilities and threats, allowing errors to be corrected and system misuse to be minimized.

The implications for adhering to an effective data security and integrity guideline related to the Project are the following –

- Data security policies and standards to be developed and adopted across GWSCCL Smart City applications and stakeholders
- Data security controls to be put in place to restrict access to enterprise data based on roles and access privileges. Data audit logs should be maintained for audit trail purposes. Security controls will be able to be reviewed or audited through some qualitative or quantitative means for traceability and to ensure that risk is being maintained at acceptable levels.
- In order to adequately provide access to secured information, security needs must be identified and developed at the data level, not the application level. Database design must consider and incorporate data integrity requirements.
- Procedures for data sharing need to be established. Data integrity during data synchronization needs to be ensured across the enterprise.
- Audit Capabilities: The system provides for a system-wide audit control mechanism that works in conjunction with the RDBMS.
- Maintaining Date/Time Stamp and User Id: Every transaction, with a date and time and User ID, is captured. The system allows generating various audit reports for verification.
- Access Log: The GWSCCL Project should have extensive inbuilt security and access control mechanisms. Based on this, the system keeps track of the various functions accessed by any users.

2. Audit Trail & Audit Log

Audit trails or audit logs should be maintained. Log information is critical in identifying and tracking threats and compromises to the environment.

There are a number of devices and software that should be logged which include hardware & software based firewalls, web servers, authentication servers, central/domain controllers, database servers, mail servers, file servers, routers, DHCP servers etc.

It is essential to decide what activities and events should be logged. The events which ideally should be captured include

- Create, read, update and delete of confidential information;
- User authentication and authorization activities in the system, granting, modification or revoking of user access rights;
- Network or service configuration changes;
- Application process start up, shutdown or restart, abort, failure or abnormal terminations, failure of network services;
- Detection of suspicious activities such as from Intrusion Detection and Prevention system, anti-virus, anti-spyware systems etc.

10.6 Application Security

- Project must comply with the Application Security Plan and security guidelines of Government of India as applicable
- Secure coding guidelines should be followed. Secure coding guidelines should include controls against SQL injection, command injection, input validation, cross site scripting, directory traversal, buffer overflows, resource exhaustion attacks etc. OWASP Top 10 standard should be mapped in the secure coding guidelines to cover all major vulnerabilities.
- Validation checks should be incorporated into the application to detect any corruption of information through processing errors or deliberate acts.
- Data output from an application should be validated to ensure that the processing of stored information is correct and appropriate to the circumstances
- Should implement secure error handling practices in the application
- Project should have Role based access, encryption of user credentials. Application level security should be provided through leading practices and standards including the following:
 - Prevent SQL Injection Vulnerabilities for attack on database
 - Prevent XSS Vulnerabilities to extract user name password (Escape All Untrusted Data in HTML Contexts and Use Positive Input Validation)
 - Secure Authentication and Session Management control functionality shall be provided through a Centralize Authentication and Session Management Controls and Protect Session IDs from XSS
 - Prevent Security Misconfiguration Vulnerabilities (Automated scanners shall be used for detecting missing patches, misconfigurations, use of default accounts, unnecessary services, etc. maintain Audits for updates
 - Prevent Insecure Cryptographic Storage Vulnerabilities (by encrypt off-site backups, ensure proper key storage and management to protect keys and passwords, using a strong algorithm)
 - Prevent Failure to Restrict URL Access Vulnerabilities (By providing authentication and authorization for each sensitive page, use role-based authentication and authorization and make authentication and authorization policies configurable
 - Prevent Insufficient Transport Layer Protection Vulnerabilities (enable SSL for all sensitive pages, set the secure flag on all sensitive cookies and secure backend connections
 - Prevent Id Redirects and Forwards Vulnerabilities
 - For effective prevention of SQL injection vulnerabilities, MSI should have monitoring feature of database activity on the network and should have reporting mechanism to restrict or allow the traffic based on defined policies.

10.7 Infrastructure Security

The following focused initiatives to discover and remedy security vulnerabilities of the IT systems of GWSCCL Smart City should be considered to proactively prevent percolation of any threat vectors -

- Deploy anti-virus software to all workstations and servers to reduce the likelihood of security threats;
- Deploy perimeter security technologies e.g. enterprise firewalls to reduce the likelihood of any security threat;
- Deploy web content filtering solutions to prevent threats from compromised websites to help identify and block potentially risky web pages;
- Install enterprise-level e-mail anti-security software to reduce vulnerability to phishing and other e-mail security spams. This would check both incoming and outgoing messages to ensure that spam messages are not being transmitted if a system becomes compromised.
- Perform periodic scanning of the network to identify system level vulnerabilities
- Establish processes for viewing logs and alerts which are critical to identify and track threats and compromises to the environment. The granularity and level of logging must be configured to meet the security management requirements.
- Deploy technology to actively monitor and manage perimeter and internal information security.
- Deploy network Intrusion Detection System (IDS) on the perimeter and key points of the network and host IDS to critical systems. Establish process to tune, update, and monitor IDS information.
- In case of cloud deployment, cloud services can be disrupted by DDoS attacks or misconfiguration errors which have the potential to cascade across the cloud and disrupt the network, systems and storage hosting the cloud application.
- Deploy security automation techniques like automatic provisioning of firewall policies, privileged accounts, DNS, application identity etc.

Network Security for Smart Devices

The core principles of security for any smart device network rest on the three most important data security concerns of confidentiality, integrity and authentication. Hence the security for smart device networks should primarily focus on the protection of the data itself and network connections between the nodes. From a network perspective, following are to be considered for designing the smart devices network -

- Protection of fair access to communication channels (i.e. media access control)
- Concealing of physical location of the nodes
- Defence against malicious resource consumption, denial of service, node capturing and node injection
- Provision for secure routing to guard the network from the effects of bad nodes
- Protection of the mobile code

Smart devices have a triple role in most networks - data collectors, processors and traffic forwarders for other devices in the network. The typical attacks for which countermeasures are to be defined and implemented are: Radio Jamming, Nodes Reporting Wrong Data, Data Aggregation Attacks and Battery Attacks.

The following guidelines need to be considered for security enhancement of smart devices and their networks:

- Use of IP-based network for smart devices
- Use of Link Layer Security for password-based access control and encryption
- Protection of smart devices nodes behind a firewall for carrying out SSL-based application data transfer and mechanism to avoid distributed DoS attacks
- Public-key-based authentication of individual devices to the network and provisioning them for secure communications
- Conformance of the security solution to the standards of IETF, IEC and IEEE to ensure maximum security and interoperability, with support for the following commonly used protocols at a minimum
 - IPSec/IKE, SSH and SSL/TLS

10.8 Software Development Lifecycle

Continuous Build

The Warangal Project should be highly modular and parallel development should be carried out for faster execution using industry's best Software Development Lifecycle practices. All application modules within the same technology platform should follow a standardized build and deployment process.

A dedicated 'development / customization' environment should be proposed and setup. The MSI must provision separate development and testing environment for application development and testing. Any change, modifications in any module must follow industry standard processes like change management, version control and release management in large and complex application development environment.

Application source code could be maintained in source control and could be broken up into a number of projects. Source control projects are created to abstract related set of modules or feature that can be independently included in another application.

It is a mandatory to create, update and maintain all relevant documentation throughout the contract duration. Also it should be ensured that a bug tracking tool is maintained for proper tracking of all bugs fixes as per various tests conducted on the application.

10.9 Quality Assurance

A thorough quality check is proposed for the Warangal Project and its modules, as per standard Software Development Life Cycle (SDLC). MSI is expected to lay down a robust Quality Assurance program for testing of the developed application for its functionality, performance and security before putting in production environment. The program must include an overall plan for testing and acceptance of system, in which

specific methods and steps should be clearly indicated and approved by GWSCCL. MSI is required to incorporate all suggestions / feedback provided after the elaborate testing of the system, within a pre-defined, mutually agreed timeline. MSI must undertake the following:

- Outline the methodology that will be used for testing the system.
- Define the various levels or types of testing that will be performed for system.
- Provide necessary checklist/documentation that will be required for testing the system.
- Describe any technique that will be used for testing the system.
- Describe how the testing methodology will conform to the requirements of each of the functionalities and expected outcome.
- Indicate / demonstrate to GWSCCL that all applications installed in the system have been tested.

10.10 Performance and Load Testing

MSI is expected to implement performance and load testing with following features:

- Testing workload profiles and test scenarios based on the various functional requirements should be defined. Application as well as system resource utilization parameters that need to be monitored and captured for each run also needs to be defined.
- Should support application testing and API testing including HTTP(s), web services, mobile applications and different web 2.0 frameworks such as Ajax/Flex/HTML5.
- MSI should perform the load testing of Warangal Project for multiple workload profiles, multiple scenarios, and user loads to handle the envisaged users of the system.
- Different activities before load testing i.e. identification of work load profiles, scenarios, information capturing report formats, creation of testing scripts, infrastructure detailing and workload profile should be prepared before the start of actual load testing exercise.
- Solution parameters needs to be tuned based on the analysis of the load testing reports. The tuning process could be iterative until the issues are closed. Multiple load runs needs to be executed for users to simulate different scenarios, such as peak load (year end, quarter end, etc.), load generation within the LAN, Load generation across WAN or mobile network simulator while introducing configurable latency/jitter/packet loss etc.
- Should eliminate manual data manipulation and enable ease of creating data-driven tests.
- Should provide capability to emulate true concurrent transactions.
- Should identify root cause of performance issues at application or code level. Include code performance analysis to quickly pinpoint component-level bottlenecks: Slowest classes and methods, most frequently called methods, most costly (aggregate time spent for each method), response time variance etc.

- Should allow selection of different network bandwidth such as analog modems, ISDN, DSL, or custom bandwidth.
- Should be able to monitor various system components e.g. Server (OS, Web, Application & Database) Monitoring, Network (between Client & Server) Delay Monitoring, Network Devices (Firewall, Switch & Router) Monitoring during the load test without having to install any data capturing agents on the monitored servers/components
- Should correlate response times and system performance metrics to provide quick insights in to root cause of performance issues.
- Reports on following parameters (but not limited to) such as transaction response time, transaction per second (Passed), user interface rendering time, transaction per second (Failed), web transaction breakdown graphs, hits per second, throughput, HTTP responses per Second, pages downloaded per second, system infrastructure performance metrics etc.
- Should provide End-to-End system performance analysis based on defined SLAs. Should monitor resource utilization including memory leakage, CPU overload and network overload. Should have the ability to split end-to-end response time for Network & Server(s) and provide drill-down capability to identify and isolate bottlenecks.

11 Annexure V: Guidelines

Common guidelines regarding compliance of systems/equipment:

1. The specifications mentioned for various IT / Non-IT components are indicative requirements and should be treated for benchmarking purpose only. MSIs are required to undertake their own requirement analysis and may propose higher specifications that are better suited to the requirements.
2. In case of addition/update in number of license for the Integrated Command and Control Centre (ICCC) software and VMS licenses for Cameras, the MSI is required to meet of technical specifications contained in the RFP and for the upward revisions and/or additions of licenses is required be made as part of change order and cost would be commensurate to the itemized rate approved at the LOI issuance.
3. Any manufacturer and product name mentioned in the Tender should not be treated as a recommendation of the manufacturer / product.
4. None of the IT / Non-IT equipment's proposed by the MSI should be End of Life product. It is essential that the technical proposal is accompanied by the OEM certificate in the format given in Volume I of this Tender, where-in the OEM will certify that the product is not end of life product & shall support for at least 6 years from the date of Bid Submission.
5. All IT Components should support IPv4 and IPv6
6. Technical Bid should be accompanied by OEM's product brochure / datasheet. MSIs should provide complete make, model, part numbers and sub-part numbers for all equipment/software quoted, in the Technical Bid.
7. MSI should ensure that only one make and model is proposed for one component in Technical Bid for example all Traffic Surveillance cameras must belong to a single OEM and must be of the same model etc.
8. MSIs should ensure complete warranty and support for all equipment from OEMs. All the back-to-back service agreements should be submitted along with the Technical Bid.
9. All equipment, parts should be original and new.
10. The user interface of the system should be a user friendly Graphical User Interface (GUI).
11. Critical core components of the system should not have any requirements to have proprietary platforms and should conform to open standards.
12. For custom made modules, industry standards and norms should be adhered to for coding during application development to make debugging and maintenance easier. Object oriented programming methodology must be followed to facilitate sharing, componentizing and multiple-use of standard code. Before hosting the application, it shall be subjected to application security audit (by any of the CERTIN empanelled vendors) to ensure that the application is free from any vulnerability; and approved by the Police Department.

13. All the Clients Machines / Servers shall support static assigned IP addresses or shall obtain IP addresses from a DNS/DHCP server.
14. The Successful MSI should also propose the specifications of any additional servers / other hardware, if required for the system.
15. The indicative architecture of the system is given in this volume. The Successful MSI must provide the architecture of the solution it is proposing.
16. The system servers and software applications will be hosted in Data Centers as specified in the Bid. It is important that the entire set of Data Center equipment are in safe custody and have access from only the authorized personnel and should be in line with the requirements & SLAs defined in the Tender.
17. The Servers provided should meet industry standard performance parameters (such as CPU Utilisation of 60 percent or less, disk utilisation of 75 percent or less). In case any non-standard computing environment is proposed (such as cloud), detail clarification needs to be provided in form of supporting documents, to confirm (a) how the sizing has been arrived at and (b) how SLAs would be met.
18. MSI is required to ensure that there is no choking point / bottleneck anywhere in the system (end-to-end) and enforce performance and adherence to SLAs. SLA reports must be submitted as specified in the Bid without fail.
19. All the hardware and software supplied should be from the reputed Original Equipment Manufacturers (OEMs). Police Department reserves the right to ask replacement of any hardware / software if it is not from a reputed brand and conforms to all the requirements specified in the tender documents.
20. Cameras, Network Video Recorder (NVR) and the Video Management / Video Analytics Software should be ONVIF Core Specification '2.X' or 'S' compliant and provide support for ONVIF profiles such as Streaming, Storage, Recording, Playback, and Access Control.
21. MSI shall place orders on various OEMs directly and not through any sub-contractor / partner. All licenses should be in the name of the GWSCCL
22. Technical Solution and Architecture : All the components of the Technical Architecture which should comply with the published eGovernance standards, frameworks, policies and guidelines available on <http://egovstandards.gov.in> and leading industry standards.
23. Consider architecture design with respect to scalability, inter-operability , availability, manageability and comply with framework Smart City (K-15016/61/2016-SC-1, Government of India, and Ministry of Urban Development)

12 Annexure VI: List of Locations

12.1 Smart Parking

To be confirmed by the Planning Authority and KUDA

Sl	Place of Parking	Approximate areas extend.	Type of Vehicle parking
1.	Behind Suprabha Hotel, Hanamkonda	3000 Yards	Two wheelers and four wheelers.
2.	Beside Petrol Bunk Nakkalaguta	2,000Yards	Two wheelers
3.	Housing Board open place near Waddepalli chowrasta	1,000 Yards	Four wheelers and two wheelers.
4.	Between Railway Quarter to Kazipet Bus Stop towards Hyderabad	1500 Yards	Two wheelers and four wheelers.
5.	Somidi road, near Kazipet Police Station	1500 Yards	Two wheelers and four wheelers
6.	On Hyderabad road, near Kazipet junction.	500 Yards	Two wheelers and four wheelers
7.	Infront of Ashoka Hotel, Municipal Open Land	2500 Yards	Two wheelers and four wheelers.
8.	Engulagadda Open Land	1500 Yards	Two wheelers and four wheelers.
9.	Beside Thousand Pillars Temple, Municipal Open Land	2000 Yards	Two Wheelers, Four Wheelers.
10.	Opposite to Ratna Hotel, Pochamma Maidan	1000 Yards	Two wheelers and four wheelers
11.	Near Warangal Bus Stand	980 Sq Yards	Two wheelers and four wheelers
12.	SNM Club behind open place	600 Sq Yards	Two wheelers and four wheelers
13.	Near Under Bridge, Warangal along Rly. Track	1,000 Sq Yards	Two wheelers and four wheelers
14.	Between Shivanagar Bus Stop and Budidagadda Junction	1,000 Sq. Yards	Two wheelers and four wheelers

12.2 Traffic Junctions: Locations for Area Traffic Control System, Traffic Enforcement:

Number of Traffic Junctions to be controlled estimated at 40 as per BoQ. However, the entire junction list for City limits is provided below. Bidder should discuss with Client on the exact location and prioritize accordingly

Quantities are indicative only and not exact.

Existing traffic controllers has been installed by Stampower. Bidder shall replace all the existing systems and commission new systems after due discussion with Client.

WARANGAL POLICE LIMITS										
Sl. No.	Name of the location	ABD	Controller	2 - Arm	3 - Arm	4- Arm	PTZ	Fixed Box	ANPR	RLVD
1.	MGM Junction	Y			Y		1	3	3	3
2.	Badrakali Temple junction	Y					1	3	0	0
3.	Pochammaidan Junction	Y				Y	1	4	4	4
4.	Kashibugga Junction				Y		1	3	3	3
5.	Venkatrama Junction					Y	1	3	3	3
6.	Railway Station Junction				Y		1	2	2	2
7.	Head Post Office Junction					Y	1	4	3	3
8.	Warangal Chowrastha					Y	1	4	4	4
9.	Durgeshwara Swamy Temple Junction					Y	1	4	3	3
10.	Charbouli Junction					Y	2	2	1	1
11.	Shambunipet Junction					Y	1	3	2	2
12.	Gavicherla Cross junction					Y	1	2	2	2
13.	Pothana Junction				Y		1	3	2	2
14.	Fort Patrol Pump Junction				Y		1	3	3	3
15.	Gemini Cross Junction					Y	1	2	2	2
16.	Urusugutta Diversion Point				Y		1	2	2	2
17.	Naidu Pump Diversion Point				Y		1	2	2	2
18.	Telangana Diversion Point				Y		1	3	2	

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19.	100 feet cross road Labour colony Junction				Y			1	3	2	
20.	Enumamula Diversion Point						Y	1	2	2	
21.	80 feet road Deshaipet road Diversion Point				Y			1	3	0	0
22.	Hanuman Junction Diversion Point				Y			1	3	2	0

HANAMKONDA POLICE LIMITS

Sl. No.	Name of the location	ABD	Controller	2 - Arm	3 - Arm	4- Arm	PTZ	Fixed	ANPR	RLVD
1.	C.P.O Junction		Y		Y		1	3	3	3
2.	University Junction		NF			Y	1	4	4	4
3.	Bheemaram Junction				Y		1	3	0	0
4.	Erragattugutta KITS College Cross				Y		1	3	0	0
5.	Markaji Junction					Y	1	4	4	4
6.	Ashoka Junction		NF		Y		1	4	4	4
7.	Hanamkonda Chowrasta		NF				1	4	4	4
8.	Amrutha Junction					Y	1	4	4	4
9.	Alankar Junction					Y	1	3	3	3
10.	Mulugu T road Junction		Y		Y		1	4	3	3
11.	Peddammagadda Junction				Y		1	3	3	3
12.	Hanamkonda Bus Stand					Y	1	4	4	4
13.	Vijay Theater Junction					Y	1	3	3	3
14.	Pegadapelly Dabbala Junction				Y		1	3	2	2

Sl. No.	Name of the location	ABD	Controller	2 - Arm	3 - Arm	4- Arm	PTZ	FIXED	ANPR	RLVD
1	Kazipet Junction					Y	1	4	4	4
2	FCI Godowns						1	1	2	2
3	Fathima Junction						1	2	2	2
4	Waddepally X road					Y	1	4	2	2
5	Collector office			Y			1	2	2	2
6	Collector bungalow				Y		1	3	3	3

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7	Julywada x raod				Y	1	3	3	3
8	Adalath Junction				Y	1	4	4	4
9	Shayampet x road Junction			Y		1	4	4	4
10	SBH Junction			Y		1	3	3	3
11	Haritha Hotel Point		Y			1	2	2	2
12	Ambedkar Junction					1	4	4	4
13	St. Peter's School Junction, near Thirumala Bar & Restaurant				Y	1	4	4	4
14	Waddepally church				Y	1	3	3	3
15	Kadipikonda Diversion Point			Y		1	3	3	3
16	Golden café Diversion Point, 100 feet Road			Y		1	3	3	3
17	CSR Garden Diversion Point			Y		1	3	3	3
						54	164	141	133

12.3 Intelligent Transit System: Route Details

WARANGAL CITY AND SUBURBAN ROUTES WITH ROUTE NO'S AND BUSES							
Sl. No.	Route	Type	RTC/ Hired	R/L	No.of Buses	No.of Trips	ROUTE NO
1	KZP-WGL-1R-JNNRM	CITY	RTC	15	8	160	1
2	KZP-HZBD	CITY	RTC	39	4	24	24
3	KZP-WGL-11ROUTE-JNNRM	CITY	RTC	17	4	80	11
4	KZP-WGL-1R-ORD-RTC	CITY	RTC	15	14	228	1
5	KZP-WGL-1R-ORD-HIRE	CITY	Hired	15	3	54	1
6	HUNTER ROAD-RTC	CITY	RTC	13	6	108	3
7	HUNTER ROAD-HIRE	CITY	Hired	13	4	84	3
8	HASANPARTY-RTC	CITY	RTC	17	1	14	24
9	HASANPARTY-HIRE	CITY	Hired	17	1	14	24
10	NGO-CLY-KZPT	CITY	Hired	16	2	31	2
11	KZPT-KUC-WGL-RTC	CITY	RTC	17	6	96	11
12	KZPT-KUC-WGL-HIRE	CITY	Hired	17	4	56	11
13	RAMPOOR - RTC	CITY	RTC	24	1	16	1R
14	RAMPOOR - HIRE	CITY	Hired	24	1	20	1R
15	SHAPUR	SUB	RTC	24	1	10	50
16	CHOWTAPALLY - RTC	SUB	RTC	32	1	8	51
17	CHOWTAPALLY - HIRE	SUB	Hired	32	1	8	51
18	VANCHANGIRI	SUB	Hired	17	1	15	64
19	MADIPALLY-NGO	SUB	RTC	18	1	12	2M
20	DEVUNUR-RTC	SUB	RTC	38	1	8	30
21	DEVUNUR-HIRE	SUB	Hired	38	1	8	30
22	NALLABELLY-P	SUB	RTC	26	1	10	54
23	MALLAKPALLY	SUB	RTC	38	1	12	41
24	KUNUR-KZPT	SUB	Hired	30	1	10	40
25	PEESARA	SUB	RTC	38	4	40	44
26	KESAVAPUR-UPL	SUB	RTC	34	1	12	33
27	KAMALAPUR-B.PT	SUB	Hired	34	1	10	31
28	SEETANAGARAM	SUB	RTC	18	1	18	34
29	M.NAGARAM-K.PUR-RTC	SUB	RTC	28	1	10	32
30	M.NAGARAM-K.PUR-HIRE	SUB	Hired	28	1	10	32
31	PEDDAPENDYAL	SUB	RTC	28	1	12	43
32	MULKALAGUDEM	SUB	RTC	16	1	10	52
33	SARVAPUR	SUB	Hired	34	2	26	51
34	PULKURTHY	SUB	RTC	24	1	12	61
35	TH.PAD/CH.PALLY	SUB	RTC	24	1	16	63
36	LAXMIPUR	SUB	Hired	22	1	8	65L

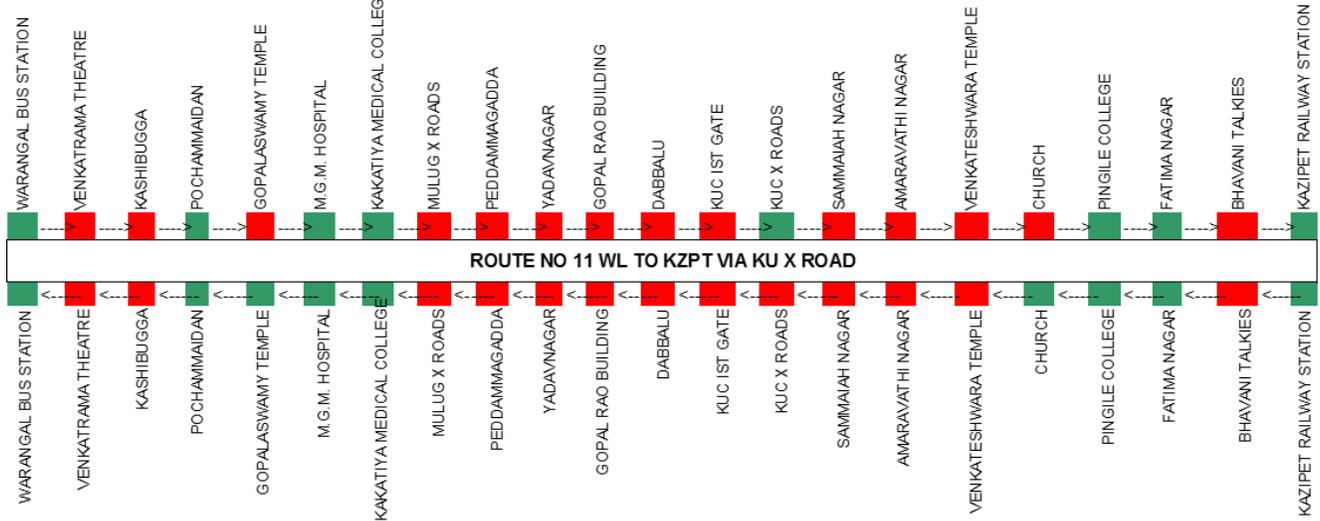
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37	SHODASPALLY	SUB	RTC	38	1	8	44
38	DHARMASAGAR	SUB	RTC	26	1	12	44
39	KUNUR-UPUGAL	SUB	RTC	34	1	10	40
40	NADIKUDA	SUB	RTC	34	1	8	17N

12.4 List of bus shelters and route info

WGL TO KZPT		KZPT TO WGL	
WARANGAL BUS STATION		KAZIPET RAILWAY STATION	
VENKATRAMA THEATRE		BHAVANI TALKIES	
KASHIBUGGA		FATIMA NAGAR	
POCHAMMAIDAN		PINGILE COLLEGE	
GOPALASWAMY TEMPLE		CHURCH	
M.G.M. HOSPITAL		VENKATESHWARA TEMPLE	
KAKATIYA MEDICAL COLLEGE		AMARAVATHI NAGAR	
MULUG X ROADS		SAMMAIAH NAGAR	
PEDDAMMAGADDA		KUC X ROADS	
YADAVNAGAR		KUC IST GATE	
GOPAL RAO BUILDING		DABBALU	
DABBALU		GOPAL RAO BUILDING	
KUC IST GATE		YADAVNAGAR	
KUC X ROADS		PEDDAMMAGADDA	
SAMMAIAH NAGAR		MULUG X ROADS	
AMARAVATHI NAGAR		KAKATIYA MEDICAL COLLEGE	
VENKATESHWARA TEMPLE		M.G.M. HOSPITAL	
CHURCH		GOPALASWAMY TEMPLE	
PINGILE COLLEGE		POCHAMMAIDAN	
FATIMA NAGAR		KASHIBUGGA	
BHAVANI TALKIES		VENKATRAMA THEATRE	
KAZIPET RAILWAY STATION		WARANGAL BUS STATION	

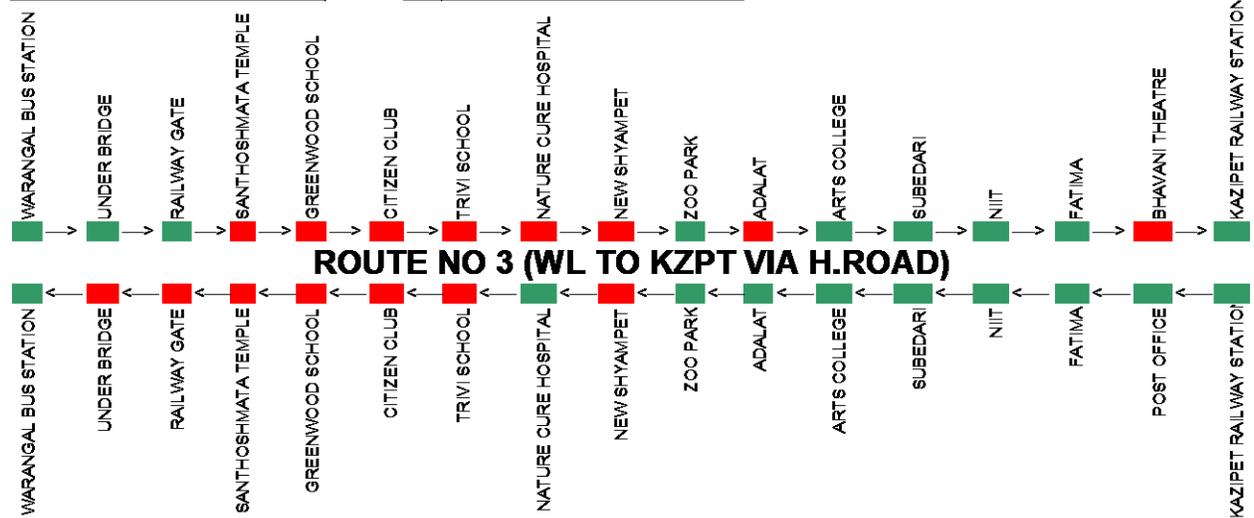
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■ BUS SHELTER EXISTING STOP



WGL TO KZPT VIA H.ROAD BUS SHELTER REQUIRED STOPS

WL TO KZPT	KZPT TO WL
WARANGAL BUS STATION	KAZIPET RAILWAY STATION
UNDER BRIDGE	POST OFFICE
RAILWAY GATE	FATIMA
SANTHOSHIMATA TEMPLE	NIIT
GREENWOOD SCHOOL	SUBEDARI
CITIZEN CLUB	ARTS COLLEGE
TRIVI SCHOOL	ADALAT
NATURE CURE HOSPITAL	ZOO PARK
NEW SHYAMPET	NEW SHYAMPET
ZOO PARK	NATURE CURE HOSPITAL
ADALAT	TRIVI SCHOOL
ARTS COLLEGE	CITIZEN CLUB
SUBEDARI	GREENWOOD SCHOOL
NIIT	SANTHOSHIMATA TEMPLE
FATIMA	RAILWAY GATE
BHAVANI THEATRE	UNDER BRIDGE
KAZIPET RAILWAY STATION	WARANGAL BUS STATION

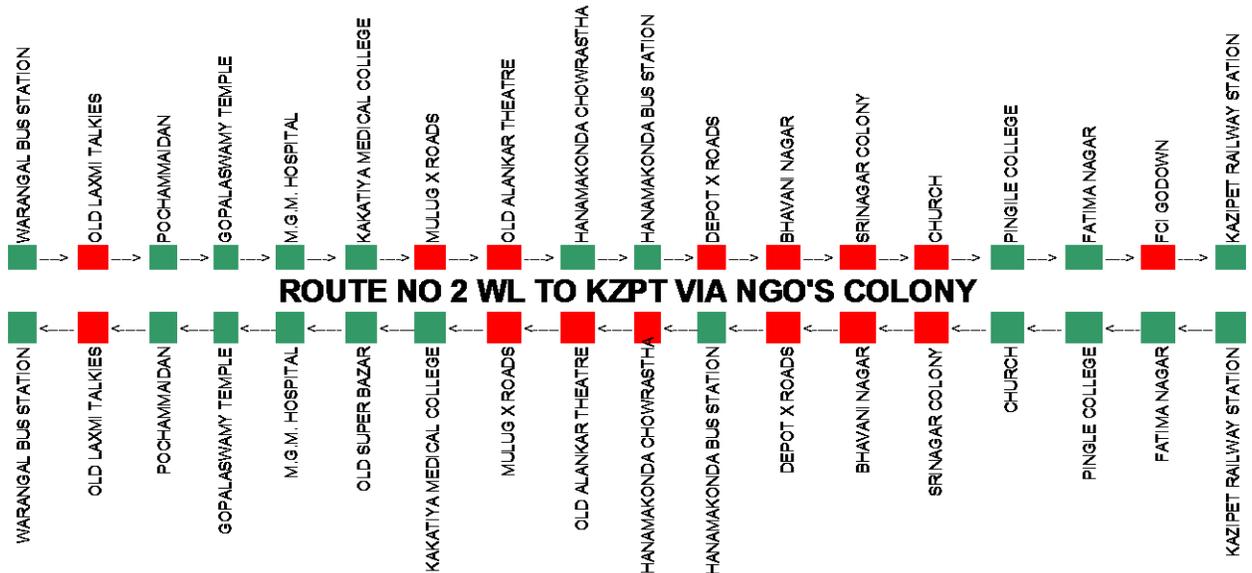
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WGL TO KZPT VIA NGO'S COLONY BUS SHELTER REQUIRED STOPS

WL TO KZPT	KZPT TO WL
WARANGAL BUS STATION	KAZIPET RAILWAY STATION
OLD LAXMI TALKIES	FATIMA NAGAR
POCHAMMAIDAN	PINGLE COLLEGE
GOPALASWAMY TEMPLE	CHURCH
M.G.M. HOSPITAL	SRINAGAR COLONY
KAKATIYA MEDICAL COLLEGE	BHAVANI NAGAR
MULUG X ROADS	DEPOT X ROADS
OLD ALANKAR THEATRE	HANAMAKONDA BUS STATION
HANAMAKONDA CHOWRASTHA	HANAMAKONDA CHOWRASTHA
HANAMAKONDA BUS STATION	OLD ALANKAR THEATRE
DEPOT X ROADS	MULUG X ROADS
BHAVANI NAGAR	KAKATIYA MEDICAL COLLEGE
SRINAGAR COLONY	OLD SUPER BAZAR
CHURCH	M.G.M. HOSPITAL
PINGLE COLLEGE	GOPALASWAMY TEMPLE
FATIMA NAGAR	POCHAMMAIDAN
FCI GODOWN	OLD LAXMI TALKIES
KAZIPET RAILWAY STATION	WARANGAL BUS STATION

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■ BUS SHELTER EXISTING STOP

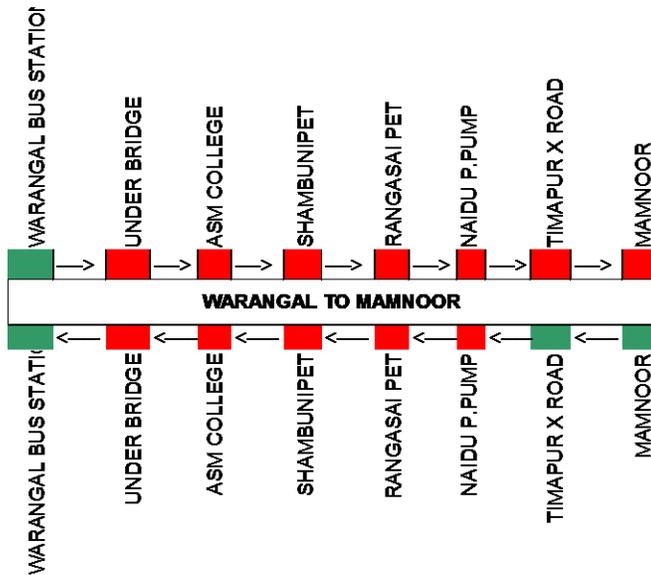


WGL TO MAMNOOR BUS SHELTER REQUIRED STOPS

WGL TO MAMNOOR		MAMNOOR TO WGL	
█	WARANGAL BUS STATION	█	MAMNOOR
█	UNDER BRIDGE	█	TIMAPUR X ROAD
█	ASM COLLEGE	█	NAIDU P.PUMP
█	SHAMBUNIPET	█	RANGASAI PET
█	RANGASAI PET	█	SHAMBUNIPET
█	NAIDU P.PUMP	█	ASM COLLEGE
█	TIMAPUR X ROAD	█	UNDER BRIDGE
█	MAMNOOR	█	WARANGAL BUS STATION

BUS SHELTER REQ. STOP

BUS SHELTER EXISTING STOP

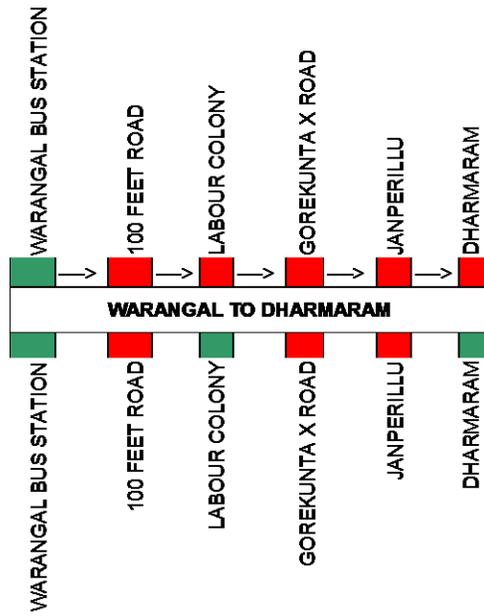


WGL TO DHARMARAM BUS SHELTER REQUIRED STOPS

WL TO DHARMARAM	
█	WARANGAL BUS STATION
█	
█	100 FEET ROAD
█	
█	LABOUR COLONY
█	
█	GOREKUNTA X ROAD
█	
█	JANPERILLU
█	
█	DHARMARAM

DHARMARAM TO WL	
█	DHARMARAM
█	
█	JANPERILLU
█	
█	GOREKUNTA X ROAD
█	
█	LABOUR COLONY
█	
█	100 FEET ROAD
█	
█	WARANGAL BUS STATION

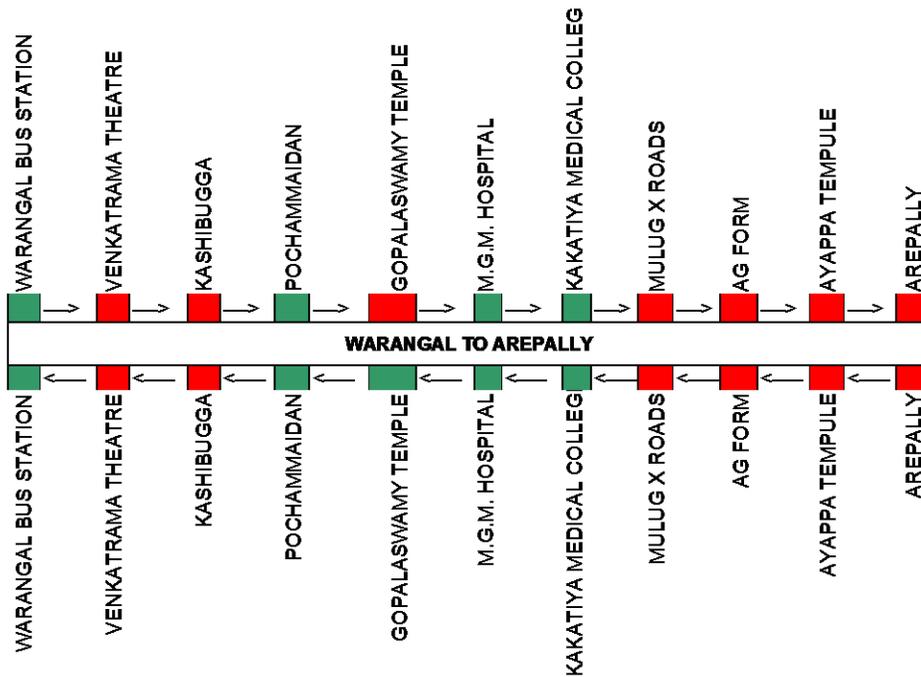
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- █ BUS SHELTER EXISTING STOP



WGL TO AREPALLY SHELTER REQUIRED STOPS

WL TO AREPALLY		AREPALLY TO WL	
	WARANGAL BUS STATION		AREPALLY
	VENKATRAMA THEATRE		AYAPPA TEMPULE
	KASHIBUGGA		AG FORM
	POCHAMMAIDAN		MULUG X ROADS
	GOPALASWAMY TEMPLE		KAKATIYA MEDICAL COLLEGE
	M.G.M. HOSPITAL		M.G.M. HOSPITAL
	KAKATIYA MEDICAL COLLEGE		GOPALASWAMY TEMPLE
	MULUG X ROADS		POCHAMMAIDAN
	AG FORM		KASHIBUGGA
	AYAPPA TEMPULE		VENKATRAMA THEATRE
	AREPALLY		WARANGAL BUS STATION

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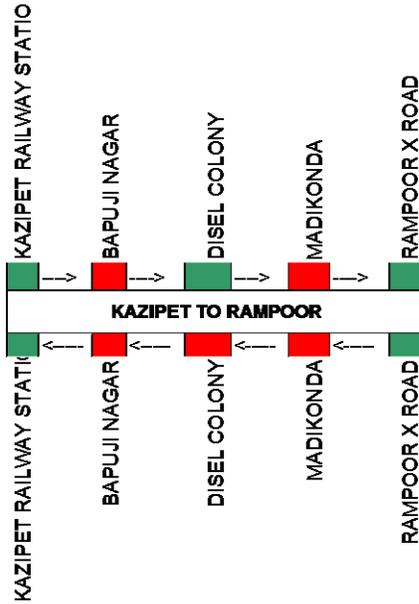


KZPT TO RAMPOOR SHELTER REQUIRED STOPS

KZPT TO RAMPOOR	RAMPOOR TO KZPT
KAZIPET RAILWAY STATION	RAMPOOR X ROAD
BAPUJI NAGAR	MADIKONDA
DISEL COLONY	DISEL COLONY
MADIKONDA	BAPUJI NAGAR
RAMPOOR X ROAD	KAZIPET RAILWAY STATION

■ BUS SHELTER REQ. STOP

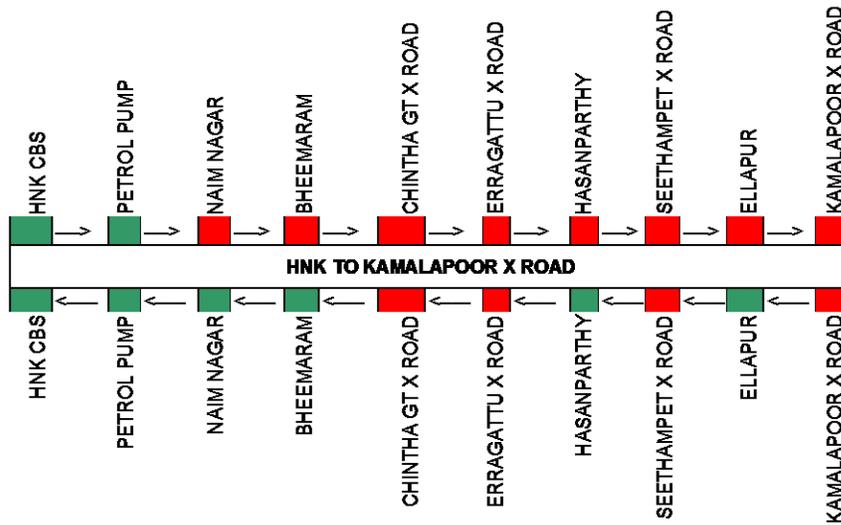
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HNK TO KAMALAPOOR X ROAD SHELTER REQUIRED STOPS

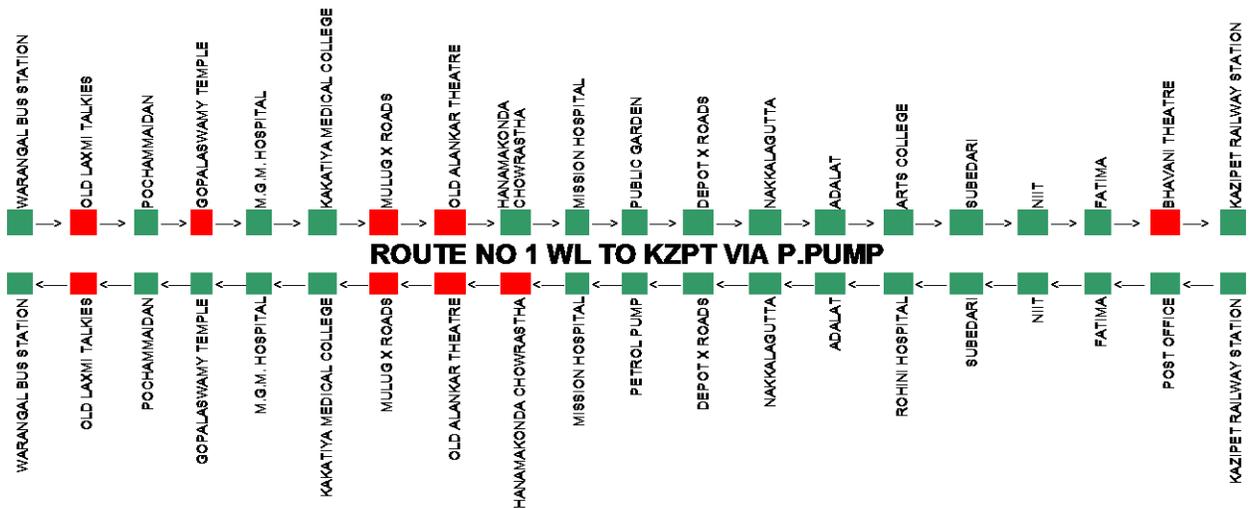
HNK TO KAMALAPOOR X ROAD		KAMALAPOOR X ROAD TO HNK	
	HNK CBS		KAMALAPOOR X ROAD
	PETROL PUMP		ELLAPUR
	NAIM NAGAR		SEETHAMPET X ROAD
	BHEEMARAM		HASANPARTHY
	CHINTHA GT X ROAD		ERRAGATTU X ROAD
	ERRAGATTU X ROAD		CHINTHA GT X ROAD
	HASANPARTHY		BHEEMARAM
	SEETHAMPET X ROAD		NAIM NAGAR
	ELLAPUR		PETROL PUMP
	KAMALAPOOR X ROAD		HNK CBS

 BUS SHELTER REQ. STOP
 BUS SHELTER EXISTING STOP

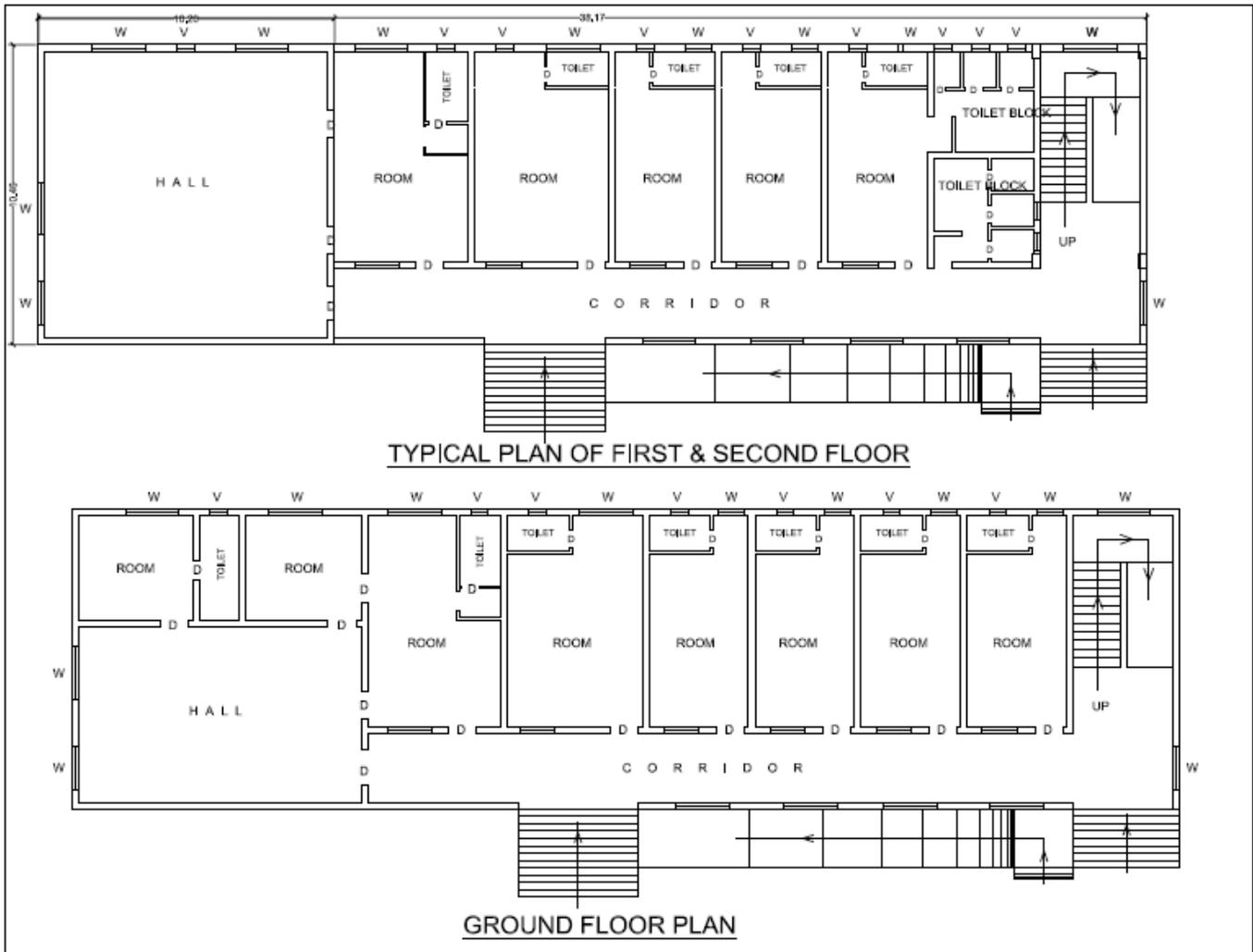


WGL TO KZPT		KZPT TO WGL	
	WARANGAL BUS STATION		KAZIPET RAILWAY STATION
	OLD LAXMI TALKIES		POST OFFICE
	POCHAMMAIDAN		FATIMA
	GOPALASWAMY TEMPLE		NIIT
	M.G.M. HOSPITAL		SUBEDARI
	KAKATIYA MEDICAL COLLEGE		ROHINI HOSPITAL
	MULUG X ROADS		ADALAT
	OLD ALANKAR THEATRE		NAKKALAGUTTA
	HANAMAKONDA CHOWRASTHA		DEPOT X ROADS
	MISSION HOSPITAL		PETROL PUMP
	PUBLIC GARDEN		MISSION HOSPITAL
	DEPOT X ROADS		HANAMAKONDA CHOWRASTHA
	NAKKALAGUTTA		OLD ALANKAR THEATRE
	ADALAT		MULUG X ROADS
	ARTS COLLEGE		KAKATIYA MEDICAL COLLEGE
	SUBEDARI		M.G.M. HOSPITAL
	NIIT		GOPALASWAMY TEMPLE
	FATIMA		POCHAMMAIDAN
	BHAVANI THEATRE		OLD LAXMI TALKIES
	KAZIPET RAILWAY STATION		WARANGAL BUS STATION

BUS SHELTER REQ. STOP
 BUS SHELTER EXISTING STOP



12.5 Command and Control Centre Floor Layout plan at GWMC



12.6 List of Surveillance Locations

Note: The following is an indicative list of all the locations proposed for Warangal Surveillance.

****However, **the bidder has to shortlist and select the locations in consultation with the Client.** In accordance with the BoQ quantities

KAZIPET		
1	PGR metal road entry	79.52731/ 18.00037
2	Pranay Baskar colony	79.53005/ 17.99838
3	Prashanthnagar Road.No.4	79.5255/ 17.9969
4	Prashanthnagar(Phase-II) Road.No.3	79.52499/ 17.99243
5	Near Tarabar Road.No.II	79.524938/ 17.99114
6	Prashanagar chowrastha	79.52777/ 17.99425
7	Telangana X road	79.53226/ 17.99425
8	Prashanthnagar water tank	79.52644/ 17.98959
9	Prashnathnagar Road.No.7	79.52489/ 17.98987
10	Opp.Merimatha Statue, Prashanth nagar	79.52978/ 17.9922
11	Akshara Jr. College road	79.53135/ 17.99357
12	Prashanthnagar Phase-I Park	79.53048/ 17.99052
13	Prashanthnagar Phase-I, Road.No.3	79.53021/ 17.99115
14	Chaithanyapuri new SBH apartment	79.53235/ 17.99198
15	Chaithanyapuri colony Venkataswamy temple turning	79.53287/ 17.99104
16	Punnami Guest house Road.no.2	79.53168/ 17.99043
17	Tara Garden	79.53148/ 17.99003
18	Bandham cheruvu road. Pragathinagar.Road.No.3	79.53461/ 17.98749
19	Ramakrishna colony, Road.no.3	79.53756/ 17.98939
20	Darga Pochamma Temple	79.53894/ 17.9771
21	Darga Ambedkar Street	79.53779/ 17.97932
22	Subash chandrabose statue	79.53637/ 17.97885q
23	Shastrinagar Y Junction	79.53514/ 17.9783
24	Back side of Grama panchayath	79.53619/ 17.97753
25	Darga chowrastha	79.53489/ 17.97733
26	In front of Darga	79.83487/ 17.97619
27	Gandhinagar to Battupally cross road	79.53575/ 17.97467
28	Opp.St.Anns Hospital	79.52602/ 17.98048
29	St.Gabrial Y-Junction	79.52026/ 17.98279
30	Siddarthnagar Excise PS	79.5223/ 17.98703
31	Siddarthnagar St.no.4	79.5205/ 17.98561
32	Near Anjaneya Temple	79.51955/ 17.98562
33	Water tank, siddarthnagar	79.51961/ 17.98384
34	Siddarthnagar community hall	79.51954/ 17.98745

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35	Venkatdrinagar Railway Line E-cabin	79.51874/ 17.98259
36	Paradise function Hall cross	79.51453/ 17.98062
37	Rahamathnagar medha school junction	79.51137/ 17.98097
38	St.John school Junction	79.51228/ 17.97995
39	Beside SBH line	79.51135/ 17.97756
40	Mudu Simhalau	79.50814/ 17.97886
41	In front of Somidi Grave yard	79.5059/ 17.98379
42	Someshwaralayam Temple, Somidi	79.50483/ 17.9862
43	Tilaknagar junction Somidi	79.50301/ 17.98164
44	Somidi Govt.Boys school Vijaynagar colony	79.50392/ 17.97797
45	Edga road	79.50358/ 17.97614
46	Vegitable market Govt.ITI college	79.50427/ 17.97432
47	Anjeneyaswamy temple, jubleemarket	79.50795/ 17.97603
48	Velangani school road	79.50762/ 17.97486
49	Ambedkar community hall	79.50153/ 17.97371
50	Pochamma temple Bapujinagar	79.5001/ 17.97273
51	Watertank Bapujinagar	79.49645/ 17.97152
52	Balajinagar Rd.6& 7	79.49393/ 17.97046
53	Vishnupuri garden bhavaninagar	79.49438/ 17.96826
54	In front of Velangani church	79.49556/ 17.96587
55	Shanthinagar Masjid	79.49697/ 17.96636
56	In front of Diesel colony park	79.49917/ 17.96691
57	In front Diesel colony arch	79.49689/ 17.96981
58	Budidhigadda bashti	79.50206/ 17.96896
59	Ramalayam temple Railway quarters	79.51161/ 17.97517
60	Nehrunagar	79.51589/ 17.98034
61	Khandhala Dhaba	79.49235/ 17.96803
62	Prasad Hospital	79.45595/ 17.96917
63	Diesel colony Arch	79.49684/ 17.97004
64	Near Kadipikonda bridge	79.5034/ 17.9724
65	Vegetable market road	79.50496/ 17.97399
66	Kazipet X road	79.5098/ 17.97362
67	Fathima bridge entry point	79.5612/ 17.98031
68	Fathima middle	79.51901/ 17.98255
69	Fathima exit point	79.52207/ 17.98428
70	Fathima X road	79.52415/ 17.98571
71	100 feet road haveli	79.53282/ 17.98953
72	A to Z medical shop	79.5362/ 17.99123
73	Fathima x road	79.52415/ 17.98571
74	Waddepally lake Subramanyeshwara swamy temple	79.52446/ 17.98723
75	Tara bar X road	79.524938/ 17.99114

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76	PGR Non A/c function hall	79.5255/ 17.99797
77	PGR Apartment	79.52731/ 18.00037
78	Havel X road	79.53282/ 17.98953
79	Revival Church	79.53419/ 17.988
80	Pragathinagar road.No.3	79.53467/ 17.98749
81	DRDA office	79.53768/ 17.9834
82	PF office	79.53174/ 17.98475
83	Bandham cheruvu Y junction	79.53905/ 17.98016
84	Pochamma temple road	79.53894/ 17.9771
85	St.Gabrial Junction	79.52009/ 17.98217
86	St.Anns Hospital	79.52596/ 17.98055
87	Fathimanagar Jendalu	79.53024/ 17.97881
88	Darga Chowrasta	79.53489/ 17.97733
89	Battupally X road	79.53575/ 17.97467
90	Vishnupuri Water tank	79.5084/ 17.97828
91	Vishnupuri Swetharka road	79.50818/ 17.97819
92	Mahankali temple road	79.50778/ 17.97979
93	Hindu barrel ground	79.5059/ 17.98379
94	Somidi Gandhi statue	79.50305/ 17.9865
95	Somidi hanuman temple X road	79.50122/ 17.98708
96	Tekulagudem road	79.50085/ 17.98772
97	Diesel loco shed	79.49889/ 17.96538
98	Under Kadipikonda bridge	79.50419/ 17.97065
99	Railway Hospital	79.50887/ 17.9742
100	In front of Railway station	79.51052/ 17.97527
101	Railway Parcel office road	79.51275/ 17.97679
102	Shanthinagar water tank	79.49697/ 17.96636
103	Railway C cabin	79.51874/ 17.98259
104	Babucamp Pochamma Temple	79.51863/ 17.9846
105	Beside track of waddepally lake	79.51964/ 17.98809
106	Fathimangar E-Cabin	79.52399/ 17.97833
107	Afzal nagar (beside track)	79.52356/ 17.5323
108	Darga shivalayam	79.52362/ 17.5562
109	Venkatadrinagar Street.No. 1-5	79.51628/ 17.98086
110	Venkatadrinagar Street.No. 6-7	79.51628/ 17.98086
111	Hanuman Temple	79.51531/ 17.98384
112	Nehrunagar- Senior Section Engineer	79.51863/ 17.98115
113	Town railway station/ Siddarthangar Road.No.5	79.51924/ 17.98278
114	Waddepally lake Road.No.10	79.51964/ 17.98809
115	Waddepally temple back side	79.53685/ 17.9873

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116	Waddepally barrel ground	79.52161/ 17.98724
117	Pochamma temple	79.51863/ 17.9846
118	Back side lotus apartment	79.52687/ 17.88421
KUC Colony Area Cameras		
119	Shankar nagar , vidyaranyaपुरी	18.022345,79.548572
120	Reddy puram Bridge	18.018083,79.576876
121	B.C colony,Gundlasingaram	18.024886,79.563290
122	Gundlasingaram bridge	18.024872,79.564301
123	Gundlasingaram bridge	18.02481,79.56422
124	Sapthagiri colony	18.005831,79.526628
125	RTC colony	18.005831,79.523778
126	Rangulafactory railway gate	18.007655,79.515666
127	Rangulafactory railway gate	18.007722,79.515480
128	Gundlasingaram IMFL center	18.024440,79.566711
129	Indiramma colony root	
130	gundlasingaram	18.026494,79.567653
131	Near sri datha apartment,parimalacolony	18.024440,79.566711
132	Jawar colony	
133	Beside shubanandini chitfunds, jawahar colony	18.008612,79.531322
134	Dwaraka sai colony phasw-1	18.01249,79.53379
135	Thallamanduwa,gopalpur	18.010673,79.533323
136	Komatipalli rail way gate	18.017422,79.535165
137	Subash nagar	18.020092,79.541435
138	Vidyaranyaपुरी	18.020033,79.544220
139	Surabhi hotal back side	18.021000,79.550144
140	Svs girls college lane	
141	Sri vijayaganapathi temple	18.024143,79.544686
142	Sathya sai colony-10,9	18.026963,79.539916
143	S.C colony bheemaram	18.030623,79.539707
144	Bheemaram bodrai,	18.033472,79.537386
145	Gollawada, janda gadde bheemaram	18.028760,79.536756
146	Kakatiya nagar	18.025710,79.536955
147	Kakatiya nagar	18.025722,79.536910
HANAMKONDA		
148	Mulugu Road Junction	18.000239,79.583329
149	Alankar Junction	18.003336,79.57882
150	Thousand Pillars Temple	18.004795,79.574893
151	Amrutha Junction	18.005474,79.572619
152	Hanamkond Chowrastha/Shivashakthistal	18.005864,79.571479

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153	Hanamkonda Chowrastha/Mahendra	18.006206,79.570647
154	Hanamkonda Chowrastha	18.005823,79.570771
155	Bus stand	18.006553,79.569923
156	CP Reddy Complex	18.007694,79.568135
157	Ahoka Junction	18.008393,79.567095
158	Green Bawarchi Biryani Point	18.009990,79.564917
159	Chintal Narsing Book Stall	18.010489,79.56243
160	Lashkar Bazar	18.009746,79.559537
161	CPO Junction	18.010976,79.558738
162	Police Head quarters Bus stop	18.012813,79.557188
163	Vaagdevi College lane	18.014539,79.555824
164	Naimnagr Mori	18.015861,79.554687
165	Rang Bar lane	18.017998,79.552852
166	Near Andhra Bank	18.018830,79.552107
167	Alankar Bar/Gopalpur Road	18.020741, 79.550547
168	KUC Juntion	18.017952,79.54678
169	KUDA colony	18.019324,79.548695
170	Gopalpur X Road	18.021509,79.557371
171	KUC 1st Gate	18.020302,79.561989
172	Pegadapally dabbal	18.018135,79.56492
173	Kothur Transfermer bridge	18.016859,79.569641
174	Reddycolony / AGR Garden	18.014960,79.576322
175	Yadavanagar X Road	18.012673,79.576041
176	Gollapally, Petrol pump	18.007437,79.582517
177	Dreamland Function hall	18.005610,79.585525
178	Peddammagadda X Road	18.004804,79.584151
179	Towards Alankar	18.004804,79.584151
180	MS Reddy Complex	18.004570,79.570191
181	Vijayatalkies lane	18.003738,79.570084
182	Balanjaneya Temple	18.002312,79.569804
183	Bus stand, Near Shilpa lodge	18.002325,79.566778
184	Bus stand Junction	18.002662,79.565526
185	Asianmall	18.004614,79.563404
186	CP Building	18.008456,79.558984
187	Public Garden Main Gate	
188	Kumarpally Market	
189	Pochammakunta Area	
190	Kumarpally Market/Trims	
191	Kothur Transfarmer	
192	A1 Mutton Shop	
193	Tailorstreet Rajivgandi Junction	

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194	Gudibandal Junction	
KUC MAIN ROAD		
195	Kits X road	18.051851,79.531088
196	Kits college lane	18.054310,79.534940
197	S.R.S.P canal chintagattu 1	18.047739,79.533053
198	S.R.S.P canal chintagattu 2	18.047178,79.533392
199	Bheemaram center	18.031043,79.542120
200	Ku police station	18.029067,79.543567
201	SDLCE cross (bharath cafe)	
202	KU 1st gate	
203	Pegadapalli dabbalu	
204	Ku campus root	
205	Pegadapalli dabbala bridge	
206	Yadavnagar cross	
207	Gopalpur X road	
208	Waddepalli cross	
MATWADA		
209	Mulug X road	18.000154, 79.583373
210	Dathakshtram	18.005091, 79.590647
211	Hanuman Junction	18.008476, 79.595656
212	Doctors colony-I	18.003961, 79.596419
213	SRSP Canal	18.002431, 79.595990
214	Thummalakunta X road	17.997405, 79.596653
215	Doctors Colony-II Bridge	17.997538, 79.604303
216	Doctors Colony-II	17.998599, 79.604303
217	Snehanagar	18.000466, 79.605448
218	Minority Colony	18.002425, 79.603506
219	Filter bed X road	17.996038, 79.607723
220	Bank Colony-II	17.994040, 79.606022
221	Ramnathapuri road-1	17.995104, 79.604756
222	Ramnathapuri road-2	17.994625, 79.605807
223	Ramnathapuri road-3	17.995135, 79.604391
224	Ramnathapuri road-4	17.994716, 79.602674
225	Balaji Temple	17.995247, 79.604595
226	Marrivenkataiah Colony-1	17.992574, 79.604541
227	Marrivenkataiah Colony-2	17.993125, 79.603554
228	Marrivenkataiah Colony-3	17.991982, 79.604466)
229	Marrivenkataiah Colony-4	17.992839, 79.602503

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230	80 feet road cross	17.990869, 79.603758
231	Shanthinagar	17.992186, 79.602685
232	Gayatri Colony road-1	17.994053, 79.600174
233	Gayatri Colony road-2	17.994553, 79.600121
234	Gayatri Colony road-3	17.994747, 79.599853
235	Autonagar Junction	17.996808, 79.597213
236	Autonagr Graveyard	17.995849, 79.596559
237	Autonagar Center	17.995033, 79.595475
238	Autonagar X road near Green Honda Showroom	17.993165, 79.592289
239	Eye Hospital lane	17.993298, 79.592675
240	Vaaritha office lane	17.990512, 79.595100
241	Arka Hospital Lane	17.990145, 79.595733
242	Gopalswamy Temple bus stop	17.989155, 79.597235
243	Reliance Trends lane	17.989247, 79.599402
244	BSNL Bhavan, Pochammaidan	17.988400, 79.600850
245	Pochammaidan Center	17.987767, 79.601612
246	Mandi Bazar Junction	17.985971, 79.599949
247	Mandi Bazar Jhanda	17.985876, 79.599820
248	Yellambazar lane near Nirmala Maal	17.983441, 79.599241
249	Vishwakarma Street at Apna Pan Shop	17.981298, 79.598715
250	DS Temple lane	17.980002, 79.598662
251	Dolphin Hotel lane	17.978552, 79.598715
252	Warangal Chowrastha	17.976818, 79.598082
253	Pinnavari Street	17.977910, 79.596570
254	Chalikam Damodar Lane	17.981073, 79.598522
255	Yellambazar junction	17.982757, 79.597492
256	Yellambazar market	17.985328, 79.597782
257	Moulali Mazid	17.984846, 79.596591
258	Matwada Bodrai	17.987502, 79.597653
259	SSK Bhavan	17.985291, 79.594878
260	Matwada junction near old CCS	17.989207, 79.597361
261	Ex. Minister House lane	17.988742, 79.599828
262	Ratna Hotel lane	17.988686, 79.599995
263	Suffa School	17.987880, 79.600451
264	Ratna Hotel Lane	17.988217, 79.600687
265	Venurao Colony lane	17.989227, 79.598278
266	Venurao Colony Junction	17.989217, 79.598396
267	Venurao Colony (near Sravani Bar Bommalagudi)	17.989212, 79.597801
268	Gopalswamy Temple	17.989222, 79.597221
269	Duttons School lane	17.989222, 79.597409
270	MGM Gate-I	17.991544, 79.592828

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271	MGM Gate-II	17.991197, 79.593504
272	MGM Gate opposite Shankar Vilas	17.991140, 79.591540
273	Mortuary junction	17.988089, 79.592200
274	Pothananagar road near Edga	17.987698, 79.591506
275	Pothananagar Sub-Station	17.987043, 79.590403
276	Rajeev Colony road	17.985589, 79.590537
277	Papaiahpet Road	17.982558, 79.590409
278	O.S. Nagar Road	17.984125, 79.590167
279	Kunti Bhadraiah Temple	17.982340, 79.592046
280	Babhi function hall lane	17.979978, 79.591811
281	Moksharam	17.979880, 79.591442
282	Seven Mories junction	17.974896, 79.593490
283	Santosh Matha Colony	17.975587, 79.588904
284	Brudhavana Colony	17.976291, 79.588990
285	Sainagar Lane	17.976949, 79.583331
286	Bondi Vagu Bridge	17.977605, 79.581773
287	Afzal Pan Shop opposite Railway Gate	17.974558, 79.596700
288	Old Beat Bazar near Natraj Kiranam	17.974845, 79.595883
289	Old Beat Bazar near Shanmukha Bar	17.976224, 79.59545
290	Arya Vyshya Bhavan	17.977156, 79.594835
291	Ramannapet near Gundu Sudharanni Residence	17.977714, 79.594833
292	Venkateshwara Swamy Temple	17.981733, 79.595325
293	Keyes High School lane	17.984298, 79.593133
294	Yellambazar lane	17.984144, 79.598618
295	Yellambazar lane opposite Venkateshwara Swamy Temple	17.981733, 79.595325
296	New Sita Rama Anjaneya Temple, Yellambazar	17.983442, 79.594894
297	GWMC	17.990401, 79.591492
298	Papaiahpet Chaman	17.983135, 79.595102
299	Musical Garden	17.991146, 79.588971
300	Bhadrakali Arch-SVP road	17.994054, 79.591047
301	Govt. Polytechnic Back side junction	17.993069, 79.587780
302	Saraswathi Temple	17.993438, 79.586259
303	Bhadrakali Temple	17.994829, 79.582898
304	Bhadrakali Bund	17.996829, 79.579658
305	Rangampet Jhanda	17.995629, 79.587735
306	Central Prison opposite	17.994064, 79.591559
307	KMC	18.001389, 79.591078
308	Shalimar Café	17.997178, 79.588357
309	Ekashila Hotel	17.998227, 79.586262
310	Industrial Estate road	17.999212, 79.584985
311	Bhadrakali Temple Road	17.994873, 79.584639

312	Innerwheel Function hall	17.991637, 79.600834
313	Padmavathi Jr. college Junction	17.988738, 79.603249
314	Sainagar Colony	7.976955, 79.583389
315	Pinnavari Street Junction near Gande Naveen house	17.980126, 79.59664
316	Mandi Bazar junction near Ex Minister House	17.988820, 79.599409
317	Kothawada Thota Maidanam	17.9995940, 79.600979
318	Infront of PS Matwada	17.986223, 79.592396
MILLS COLONY		
319	Under Bridge	17.973314,79.600604
320	Shivanagar Rail way station	17.972695,79.605002
321	Budidhi gadda	17.96986,79.598054
322	ASM College X road	17.964568,79.5982
323	Fort road 1st X road	17.962023,79.600475
324	Fort road cross road	17.959982,79.60114
325	In front of PS Mills colony	17.957363,79.601612
326	Shambunipet junction	17.948265,79.599273
327	Gavichera X road	17.94634,79.599187
328	Telangana colony X raod	17.942671,79.598544
329	RTO office Junction	17.938813,79.596956
330	In front of Ganapathi engineering college	17.944039,79.590518
331	In front of Thalla Padmavathi college	17.952858,79.585347
332	Ursu gutta Junction	17.963492,79.584897
333	Buttu pally Cross road	17.965452,79.58421
334	Wims Hospital	17.974433,79.579296
335	In front of Keerthi Bar	17.970231,79.593201
336	In front of Ram Laxman Guraden	17.966415,79.591591
337	Dasra road X road	17.964904,79.590991
338	Chetlonigadda	17.959352,79.591076
339	In front of Sathish bomma Junction	17.95776,79.593029
340	Ursu bodrai	17.957229,79.593673
341	Nehru statue , Rangashaipet	17.946631,79.596634
342	In front of Govt maternity Hospital, ursu	17.956756,79.59172
343	Budigajangala Colony	17.947223,79.602685
344	Telangana Thalli Bomma	17.940201,79.598951
345	Janama Bhumi junction	17.963778,79.595883
346	Shanthi nagar X road	17.969412,79.596977
347	In front Maisamma Temple,	17.970202,79.615753
348	Chinthal center	17.968085,79.617426
349	Fort Warangal Thornalla	17.956491,79.614637
350	East fort Hanuman temple	17.955587,79.621053
351	In front of Kushimahal	17.95643,79.613135

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352	West fort Cheman	17.955797,79.609766
353	West fort Entrance	17.956042,79.608028
354	Venkatrama Junction	17.97791,79.608661
355	O city	17.976603,79.611504
356	Telangana junction	17.973826,79.616987
357	Christina colony X road	17.97353,79.617974
358	100 feet` s road X road	17.972586,79.619395
359	Gorrekunta X road	17.967541,79.627015
360	Fly over bridge center point	17.968304,79.615144
361	In front of Indhira Gnadhi	17.968302,79.613655
362	In front of Vandana High School, Shivanagar	17.96986,79.603195
363	AC Reddy nagar, Indhira Gandhi Bomma	17.968011,79.607086
364	Shivanagar Majidh	17.97206,79.605115
365	In front of Pallavi hospital	17.972024,79.60125
366	Perukawada Rail way gate	17.974397,79.596763
SUB-ROADS		
367	Srinivasareddy colony	18.050258,79.531995
368	Narayana nagar colony	18.050334,79.531751
369	Chintagattu cross	18.045444,79.534107
370	Ganesh nagar	18.038266,79.537582
371	S.V.S college road	18.037939,79.537525
372	Radika hospital center,ramaram	18.036618,79.537952
373	Sadananda goud colony-1	18.035779,79.538822
374	Anand nagar colony-2	18.032191,79.541412
375	Durganagar road, crpf temple	18.02996,79.54303
376	Bank colony lane, opp ku police station	18.028643,79.543782
377	Vijaya ganapathi nagar	18.026517,79.545525
378	Beside star hospital,	18.025202,79.546688
379	Vijaya ganapathi nagar	18.02033,79.56215
380	Pegadapalli dabbalu	18.015940,79.574360
381	Gundla singaram root	18.018161,79.546929
382	Gouthami nagar	18.016193,79.544089
383	Madavanagar 100ft road	18.015015,79.542592
384	Pragathi nagar	18.014271,79.541730
385	Vivek nagar	18.011338,79.538236
386	Opp Thulasi bar	18.008481,79.53392
387	TNGO's colony-2	18.006479,79.532302
388	Jawahar colony X road	18.005478,79.531491
389	Jayamukhi girls college lane, waddepalli	18.005597,79.531519
390	Waddepalli cross	18.021000,79.550144
391	Surabhi hotal back side	18.021000,79.550144

HASANPARTHY		
392	Infront of Hasanparthy Police Station Main Gate	18.0556964,79.5292987
393	Opposite Nallagattu	18.058394, 79.527083
394	Keshavapur cross	18.0594779,79.5261478
395	Domhari Wada	18.0669909,79.5219374
396	Chinthagattu Cross	18.066808,79.521961
397	Jayagiri Cross	18.069431,79.520672
398	Hasanparthy Junction	18.069431,79.520672
399	Opp S.B.H bank Hasanparthy	18.070090, 79.520106
400	Kallu Manduva	18.0733249,79.5188006
401	Opposite Hanuman Temple (Hasanpathy cheruvu katta)	18.075096, 79.516934
402	Seethampet Cross	18.0795235,79.5079695
403	In front of Sri Chaithanya School gate	18.0901545,79.4898391
404	Bavupet cross	18.091646,79.486973
405	In front of SR Engineering college Main gate	18.096267,79.4697175
406	Ananthasagar cross	18.092950,79.462913
407	Peddavagu Bridge, Ananthasagar road (District border will be covered)	18.093059, 79.461783
408	Mucherla Cross	18.092859, 79.461879
409	Pembarthy Cross	18.0652853,79.548711
410	Nagaram cross	18.078561,79.54763
411	Nagaram Village Center	18.087876,79.553386
412	Paidipally Cross, RN Nagar, Near Agriculture Univercity.	18.095011, 79.567309
413	Ayyappa Swamy Temple Area	18.016676,79.602477
414	HP Petrol pump Cross near Iskon Temple	18.021362,79.603495
415	Sahasra Engineering & Pharmacy College+ (3 Other schools will be covered)	18.025340,79.60542
416	Paidipally Cross Arepally Junction	18.0259254,79.6070218
417	Vangapahad Cross Areaply Junction	18.0270559,79.6154392
418	Vangapahad Village	18.0276626,79.6157379
419	Opp SBH Bank Arepally	18.0402283,79.6119691
420	Arepally Village	18.0282240,79.6184755
421	Old Bus stand	18.0290192,79.6205696
422	Arepally Canal	18.030595,79.624336
423	Dhamera x Road	18.0329644,79.6303483
424	Kothapet Cross	18.0332727,79.6311922
SUBEDARI		
425	Waddepally Church	18.0055,79.5316
426	Javahar Colony x road	18.0083,79.5340
427	Thirumala Centre	18.0123,79.5491

Request for Proposal for Selection of System Integrator for Pan-City ICT Components for Warangal Smart City

428	Ambedhkar junction	18.0072,79.5584
429	Kaloji Junction	17.9976,79.5545
430	Adalath Junction	17.9966,79.5511
431	Collector Residency	17.996239,79.543878
432	Waddepally x Road	17.993239,79.540267
433	A to Z Medical shop	18.000689,79.531120
434	CSR Garden Junction	17.980439,79.579690
435	New Shyampet	17.989354,79.564927
436	Excise colony	17.7778,79,544885
437	District Library	18.007384,79.560782
438	Hanmakonda Bus stand	18.002649,79.565525
439	Canara Bank	17.998109, 79.555845
440	Ekashila Park	17.59532,79.33210
441	Children's Park	18.003536,79.559870
442	Captain Laxmikantha Rao House road	17.993553,79.33179
443	Raju Hotal	17.992210,79.556957
444	Nandhi Hills	17.990025,79.555892
445	Gandhi Statue New Shyampet	17.989390,79.562093
446	Julywada X Road / DIG Office	17.995116,79.547529
447	Julywada Junction	17.992628,79.547955
448	Prakashreddy peta	17.986880,79.547384
449	Shanthi Nagar Spencer's Back side	17.997705,79.551186
450	Dist. Collector Office	17.994239,79.543878
451	Revenue Colony	17.990907,79.541191
452	Telangana Junction	17.994220,79.532375
453	Teachers Colony Phase-II	17.997058,79.535732
454	Govt Pingili Mahila Degree College	18.000562,79.531073
455	Amaravathi Nagar	18.014226,79.541871
456	NGO's Colony Junction	18.005160,79.536064
457	Indira Nagar Junction	18.004558,79.542048
458	Bhavani Nagar Junction	18.004313,79.544435
459	Pochamma Temple	18.009950,79.549102
460	Raithu Bazaar Excise Colony	17.997798,79.541881
461	Ram Nagar Junction	18.005764,79.554491
462	Galaxy Bakery Junction	18.011805,79.554342
463	Vegetable market Near LIC Building	18.014295,79.541841
464	Water Tank Junction Nakkalagutta	18.002186,79.556342
465	Haritha (Kakatiya) Hotel	17.998769,79.554994
466	Circuit Guest House	18.004477,79.552132
467	Housing board Junction	18.002293,79.552081