REQUEST FOR PROPOSAL

FOR

SELECTION OF AGENCY FOR

SETTING UP ADAPTIVE TRAFFIC MANAGEMENT IN PUNE CITY

Volume 2 - Scope of Work

Tender Number: SC09-Recall-2016

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Issued By

The Chief Executive Officer

PUNE Smart City Development Corporation Limited (PSCDCL)

PMC Building, Near Mangla Theatre, Shivaji Nagar, Pune-411 005

Table of Contents

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2. Glossary

Terms	Meaning
BOM	Bill of Material
BEC	Bidders Evaluation Committee
Bidder	Sole Bidder or the Consortium of firms in case of Consortium
CC	Capital Cost (CC1-Capital Cost 1, CC2 - Capital Cost 2)
CCTV	Closed Circuit Television
CEO	Chief Executive Officer
DD	Demand Draft
EMD	Earnest Money Deposit
GIS	Geographical Information Systems
GoM	Government of Maharashtra
GPS	Global Positioning System
ICT	Information and Communication Technology
INR	Indian Rupee
LoI	Letter of Intent
NPV	Net Present Value
OEM	Original Equipment Manufacture
PBG	Performance Bank Guarantee
PDD	Proposal Due Date
PMC	Pune Municipal Corporation
PoC	Proof of Concept
PQ	Pre-Qualification
PSCDCL	PUNE Smart City Development Corporation Limited
PSU	Public Sector Undertaking
RFP	Request for Proposal
PV	Present Value
RV	Revenue (RV1-Revenue from 1, RV2-Revenue from 2)
SI	System Integrator / Successful Bidder
SLA	Service Level Agreement
TQ	Technical Qualification
VM	Virtual Machine

3. Definitions

Term	Definition
All red	A condition when only red aspects are displayed. The All Red is executed when an abrupt signal change is required (e.g. power up, flash-to-signal, manual-to-auto, hurry call-to-auto, etc.).
Amber time	Duration of the amber display for a phase or a movement
ATCS	Adaptive Traffic Control Systems are traffic responsive systems that use data from vehicle detectors and optimize traffic signal settings in an area to reduce vehicle delays and stops.
Cable-less linking facility	A method of linking traffic signals along a corridor and / or in an area using timing information derived from their master time clock systems.
Central computer	A computer system that is connected to all traffic signal controllers under the ATCS through the communication network. The network control software runs at the Central Computer
Clearance amber	Clearance Amber is the warning signal to traffic streams approaching the Stop Line, commenced at the change of a right of way.
Communication network	A wired or wireless facility used to send and receive data between the Central Computer and the Traffic Signal Controller
Conflict plan	Any competing phases that are not allowed simultaneously are defined as conflicting phases. The Conflict plan is a listing of all conflicting groups.
Corridor	An arterial road with several intersections
Cycle plan	Each signal switching schemes make a Cycle Plan. Change of a stage switching sequence or stage timings define a new cycle plan.
Cycle	Cycle is the total time period required for one complete sequence of signal switching scheme, in which all stages are given some fixed order.
Day plan	Day Plan is the distribution of cycle plans for a particular day.
Decision support	Reports, Graphs, Traffic Simulator interface
Filter green	The Filter Green provides signal for the turning traffic. When linked with a vehicle phase the termination of filter green is blackout; otherwise it flash for few seconds (equivalent to clearance amber time) before termination.
Fixed time operation	None of the stages are preempted
Full ATCS	The signal controllers shall accept stage timings from the ATCS application and report back the operational parameters to the central server

Full VA cycle	Vehicle Actuated operation of signal controller with fixed cycle length
Full VA	Preemption enabled for all the stages
GPS (global positioning system)	A satellite-based radio navigation system developed and operated by the U.S. Department of Defense (DOD). GPS permits users to determine time, date and day of week 24 hours a day, in all weather, anywhere in the world with a precision and accuracy.
Green running period	Split time utilized for the Stage
Green wave	A scheme that give right-of-way progressively at all intersections in a corridor
Hurry call	The Hurry Call mode will provide the means to force the controller to a defined stage, without violating safety clearances.
Indicative green	The Indicative Green is a continuously flashing signal/steady signal, which provides signal for the free left turning traffic. The termination of indicative green is always blackout.
Inter green	This is the time period between the end of the green signal for one stage and the beginning of the green signal for the following stage.
Maximum green period	Maximum Green period is the maximum time period for which a green light can be in the ON state in a particular stage.
Minimum green period	This facility ensures that a phase loses right of way only after a minimum time period has elapsed. This minimum time is defined as Minimum Green Period. It will not be possible to terminate prematurely the minimum green period.
Network control software	ATCS application software that generate, monitor and manage the signal plan timings for all intersections under the ATCS.
Offset	Offset is defined as the difference between the start/termination of green time at the successive upstream and downstream signals.
Pedestrian movements	The Pedestrian phase contains two signal aspects, viz. Red and Green. The termination of pedestrian phase can be either red flash or green flash.
Performance index	A measure of effectiveness on the applied control strategy
Phase	The sequence of conditions applied to one or more streams of vehicular or pedestrian traffic, which always receive identical signal light indications. The controller provides facilities for a number of phases, each phase provide control for one of the following:
Power saving	Signal lamp intensity control based on ambient light during different time of the day.
Priority route	A route in a corridor that carry maximum volume of traffic at a given point of time.

Priority stage	A stage that is a part of the priority route
Red extension	When a right of way is terminated with Clearance amber, opening of the next right of way is delayed by the Red Extension period. With no continuing phase this gives an effect of all red between stage changes.
Right-of-way	A visual signal to go-ahead
Semi-actuation	One or more stages are not preempted in vehicle actuated signal operation
Special day plan	Holidays falling on normal weekdays can be treated as special days and can have a different day plan.
Split	A Split decides how long a Stage should remain; i.e. the duration of a given right of way.
Stage preemption	A facility to terminate a Stage execution before it reaches the Green running time set for that Stage. The Stage preemption happens when there is no continuous vehicle demand on the corresponding approach.
Stage skipping	Facility for a stage to appear only when demanded
Stage	A stage can primarily be considered as a condition of signal lights during a period of the cycle, which gives right of way to one or more traffic movements. One or more phases form a Stage (Group). Stage is a group of non- conflicting phases
Traffic lane	A lane is part of a roadway (carriageway) that is designated for use by a single line of vehicles, to control and guide drivers and reduce traffic conflicts.
Traffic management Centre (TMC)	Place where the Central Computer resides and all communication network links are aggregated.
Traffic signal controller	A microcontroller based equipment with solid state traffic signal lamp switching module.
Vehicle detector	A device that detect the presence and passage of a vehicle (cameras / virtual loops)
Vehicular movements	The Vehicle phase contains three signal aspects, viz. Red, Amber and Green. The termination of vehicle phase is always with clearance amber.
Week plan	Week Plan is the distribution of available day plans for a week.
Zone	A small area with limited no. of intersections in a city under ATCS.

4. Introduction

4.1. Project Background

Pune Municipal Corporation (PMC) under the ambit of smart city initiatives intends to utilize information technology to modernize Traffic management, Traffic control, Traffic Law enforcement and traffic information dissemination in the city to enable Pune Traffic Police in ensuring smooth traffic flow and informed road users.

Pune, a city which has urbanized rapidly in recent years, has witnessed enormous growth in traffic volumes which have, resulted in several traffic problems in and around the city, such as traffic jams, increase in number of road accidents etc. A need was felt to develop an Adaptive Traffic Management System (ATMS), which would aim at improving the efficiency and effectiveness of the traffic on Pune roads. Implementation of ATMS is an initiative taken by PSCDCL to provide a secure and pleasant road experience to citizens of Pune.

To realize the benefits of ATMS, it is pertinent to adopt an approach that includes technology based regulation, intervention, information and enforcement system to improve the mobility, discipline and safety on Pune roads. Therefore, ATMS is envisaged with multiple applications, including Adaptive Traffic Signaling, Red Light Violation Detection (RLVD) systems, Variable message sign boards, Traffic Surveillance Cameras amongst others which will ensure that the intended outcomes have been accomplished.

ATMS integrates various sub systems (such as CCTV, Vehicle detection, communication, variable message signs etc.) in a coherent single interface that provides real time data on status of traffic and predicts traffic conditions for more efficient planning and operations. Thus, a system such as ATMS shall aim to help police and security agencies to take proactive/ reactive measures and ensure safe & smooth environment on road. Wherever the current Pune City CCTV Surveillance System cameras can be utilised for the traffic management, necessary integration is expected. Such an integration scope shall be discussed with the successful bidder.

Thus PSCDCL intends to establish an ATMS through a process of competitive bidding and selecting a bidder for Supply, Installation, Commissioning and maintenance of the following:

- Adaptive Traffic Control System (ATCS) – Vehicle detectors, Signal controller, Traffic light aspects, poles, power supply provisioning and related accessories and associated civil work including cabling for successful operation of the system

- Red Light Violation Detection (RLVD) System along with related accessories and required mounting infrastructure including civil work for successful operation of the system

- Traffic Surveillance Cameras along with related accessories and required mounting infrastructure including civil work for successful operation of the system

- Establish Network Connectivity to transfer the data from field devices to the Data Center / DR and Traffic Command Center (TCC)

- Set up Traffic Command Center and Data Center (DC) with required software platform capability to aggregate incoming data streams onto a single platform, provide traffic flow estimates for near term future on a real time basis and assist in analyzing impact of alternate traffic management strategies.

- IT infrastructure including hardware and software at TCC and DC for the management of the edge devices signals, command centre and the traffic management software platform

- Develop individual signal control strategies including definition of signal grouping, setting of potential strategies for traffic control under various scenarios, specification of traffic management strategies for planned and unplanned events

- Develop a consolidated database of incoming real time data for future analysis and evaluation purposes. It is envisaged that the proposed adaptive traffic control system will incorporate historic trends for development of traffic management strategies and adaptive control strategies.

- Capacity building for various government agencies and administrative arms of PSCDCL through development of Training manuals, continuous maintenance of hardware and software for 5 years period, training of administrative and management personnel including handholding the TCC operations for 5 year

4.2. Project Objectives

The broad objectives of the project are as follows:

a. **Improve Journey Time Reliability:** Improve reliability in journey times between various locations, so that citizens can experience an enhanced quality of road based transportation, through improving sustainability and efficiency in operation of the road network

b. **Increased Traffic Signal Efficiency:** Reduction in traffic delays, optimized cycle times at intersection to regulate and maintain free flow of traffic to enhance the efficiency of the transport infrastructure.

c. **Increase Operational Efficiency:** Pune Traffic Police intends to spend more time on the public facing functions. Thus Information technology solutions should help in reducing the repetitive paperwork/records and making the back-office functions more efficient.

d. **Improve Customer Services:** The traffic services to the public can be improved through the user friendly presentation of the various traffic information in real time through sharing of all relevant data feeds for public consumption.

e. **Safety Improvement:** The real time traffic monitoring and intelligent traffic systems can prevent accidents by recognizing and thus responding to the potentially dangerous situation in advance.

f. **Higher Productivity:** Achieving improvement in the productivity, logistics and other economic activities by obtaining the precise-real time information on transport due to the availability of data on traffic flow in key areas of the city.

g. **Real Time Information, Event Tracking & Response, and Fast Access to Stored Information:** The real time information at the TCC shall enable the operator to take necessary actions based on the type of information. Sending an emergency vehicle to the spot, arranging alternate route to VIP convoys, diverting the traffic to different routes are some of the actions that can be taken based on the Real Time Information. It shall be possible to track a particular event using the cameras installed at the traffic junction. A vehicle, violating the traffic could be tracked and penalised at the next traffic junction based on the number plate.

h. **Creating awareness for public:** Through sign boards, awareness on road traffic rules and safe driving precautions shall be imparted to road users.

i. **Enforcement:** Effective enforcement of traffic violation, checking and monitoring shall reduce the traffic related offences of Red Light violations

j. **Create a platform for sharing traffic information across the city:** There is a critical need to create a platform for sharing traffic related information among traffic police and citizens in order to increase the effectiveness of Adaptive Traffic Management System.

4.3. Existing Systems

Pune traffic police has over the last few years put in a multi-layered structure of traffic signals to help commuters navigate traffic with ease. Traffic Police has already put around 336 Traffic Signal systems at various road intersections across Pune city.

Few of the surveillance cameras which have been established under the Pune Safe City project are being used to identify the traffic violators and issue Challans. Pune police has put in place a command center at Police Commissioner's office to which the various surveillance and ANPR cameras are connected.

4.3.1. Traffic & Pedestrian Signals

There are about 368 existing signals within the project jurisdiction. Detailed locations of existing and proposed signals are provided in the **Annexure IV** of this document.

4.3.2. Web Portal & Miscellaneous System

The Pune Traffic Police currently maintains a website which provides information about the various Traffic rules & regulations, road safety, emergency service, details on traffic police-public interface, Challan notice information, and road safety measures.

4.4. Other Initiatives

4.4.1. Smart City Command Center

PMC shall be undertaking multiple Smart City projects in near future, which would include installing sensors / smart devices on field and integrating, analysing data received from these field devices / sensors at a Smart City Operation Center (SCOC). The Application System and Field Devices as part of the ATC project should have provision to share necessary data to the application software at SCOC so that more informed decisions can be taken at the SCOC for normal city management or during emergency / crisis situations.

4.4.2. eChallan System

The PSCDCL, through the ATMS project also intends to provide the eChallan facility to the Traffic Police department. PSCDCL shall facilitate to get access to the Driver and Vehicle database. Bidder shall be required to access the same through use of appropriate APIs. The E Challan system should be capable of handling all violations including the RLVD system proposed as part of this RFP.

Government of Ma2harashtra may implement a centralised eChallan system, to be used across the state of Maharashtra. In such a case, SI will be required to facilitate integration of that system with the Pune ATCS system. Relevant line items from the scope of work of work from the SI shall be deleted in such a case.

5. Scope of Services for the Project

5.1. Overview

The SI has to ensure the successful implementation of the proposed Adaptive Traffic Management System (ATMS) and provide capacity building support to city authorities as per the scope of services envisaged below. Any functionality not expressly stated in this bidding document but required to meet the needs of the organization to ensure successful operations of the system shall essentially be under the scope of the SI and for that no extra charges shall be admissible.

The ATMS services will include strengthening of four key areas of traffic management within the city:
   a) Enhance Situational Awareness of existing traffic conditions on real time basis
   b) Develop ability to Assimilate and Analyze and real time traffic information and historic trends to enable automated adaptive traffic control and support decision making on traffic management strategies
   c) Create linkages to support Information Dissemination of traffic management strategies and user information through traffic controllers, Information Portal, Variable Message Signs, Web Services and APIs
   d) Ensure long term Capacity Building through training and support for city administrators

Specifically, the SI will help Pune develop and deliver the following systems and capabilities linked with centralized Command & Control Centre:
   i. Red Light Violation Detection (RLVD) system
   ii. EChallan Application
   iii. Traffic Surveillance
   iv. Real Time Traffic Analytics Platform located at Traffic Command Centre
   v. Adaptive Traffic Control System
   vi. Variable Message Sign boards

The schematic diagram below shows the systems envisaged under ATMS and the information flow across the systems to be integrated.
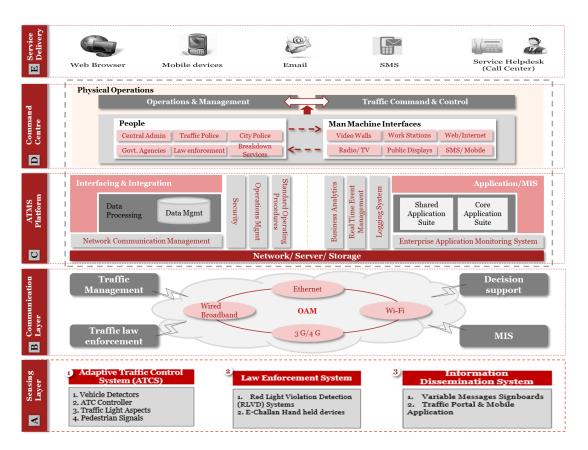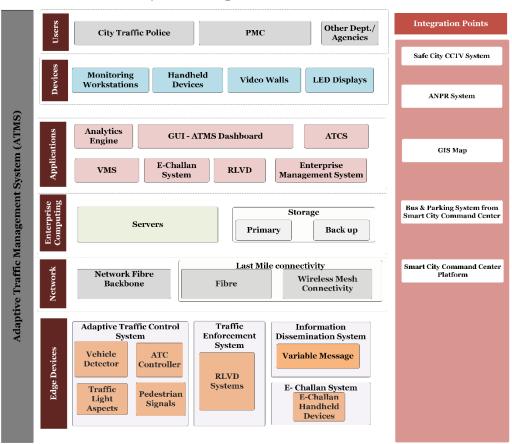
Figure: Logical Architecture of ATMS Solution

System Component Architecture

Figure: System Component Architecture of ATMS Solution

The SI'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. **Scoping and Feasibility Study**: Conduct a detailed scoping study and develop a comprehensive project plan, including:

    a. Feasibility study for finalization of detailed technical architecture and project plan

    b. Development of traffic management plans for individual signal controls and groups of signal controllers along with pre-planned intervention startegies for special scenarios

    c. Site surveys to identify need for junction improvement, junction signages, lane markings and other necessary site infrastructure

    d. Site Clearance obligations & other relevant permissions.

2. **Field Equipment**: Design, Supply, Installation and Commissioning of following field equipment envisaged in ATMS:

    a. Adaptive Traffic Control System at Signalised traffic junctions

    b. Variable Message Signs

    c. Red Light Violation Detection system

    d. E-Challan System

3. **Network Connectivity**: Design, Supply, Installation and Commissioning of Network & Backbone Connectivity for ATMS

    a. Developing necessary connectivity for ATMS

    b. Integrating live data streams from other traffic information systems such as real time public transport bus location data from PMPML systems currently under deployment, parking information systems.

4. **Hardware and Software Infrastructure**: Design, Supply, Installation and Commissioning of IT Infrastructure at TCC and DC: This shall consist of following activities:

    a. Basic Site preparation services

    b. IT Infrastructure including server, storage, other required hardware, application portfolio, licenses

    c. Centralized platform for traffic data analytics and signal optimization

    d. TCC infrastructure including operator workstations, video walls, IP phones, joystick controller etc.

    e. Establishment of LAN and WAN connectivity at TCC and DC

    f. Application Integration Services

5. **Capacity Building**: Preparation of operational manuals, training documents and capacity building support, including:

    a. Preparation and implementation of the Information security policy, including policies on backup and redundancy plan

    b. Preparation of revised traffic signal control plans, alternate signal control plans, KPIs for performance monitoring of transport network, dashboards for MIS

c. Training of the city authorities and Traffic Police personnel on operationalisation of the system

d. Acceptance testing

e. System Documents, User Documents

f. Setting up Helpdesk Services and provide support to users at Pune traffic police and other associated stakeholder locations in compliance to the defined SLAs.

6. Warranty and Annual Maintenance: provide maintenance services for the software, hardware and other IT infrastructure installed as part of ATMS project for a period of 5 years.

5.2. Geographical Scope of services

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

S.No	System Description	Locations
1.	Adaptive Traffic Control Systems	368 Locations
2.	Variable Message Sign Boards	50 Locations
3.	Red Light Violation Detection System at Intersection	33 Locations
4.	Traffic Command Center (TCC)	1 Location

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

5.3. Feasibility study for finalization of detailed technical architecture and project plan

After signing of contract, the Systems Integrator needs to deploy the team proposed for the project and ensure that a Project Inception Report is submitted to PSCDCL which should cover following aspects:

1. Names of the Project Team members, their roles & responsibilities
2. Approach & 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 bidder anticipates and the plans they have towards their mitigation.
5. Detailed Project Plan, specifying dependencies between various project activities / sub-activities and their timelines.

The SI as part of the feasibility study shall also conduct a comprehensive As-Is study of the corridors & traffic junctions/intersections (identified for ATMS) during various time periods of day including peak and non-peak hours to establish the key performance

Indicators for the ATMS projects. The KPIs of the study shall be included in the feasibility report. The following minimum parameters should be captured during the comprehensive study

1. Volumes of vehicles moving in the road network
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. Emission
7. Additional dependencies with respect to the available infrastructure and geometry at the junctions
8. Any other relevant data which the bidder anticipates will assist in establishing the benchmarks for the project

The feasibility report shall also include the expected measurable improvements against each KPI as detailed out in the above as-Is study after implementation of ATMS.

Additionally, the System Integrator should provide as part of feasibility report the detailed To-Be designs (Junction layout plans) specifying the following:

- High Level Design (including but not limited to)
    - Application architecture documents
    - ER diagrams and other data modelling documents
    - Logical and physical database design
    - Data dictionary and data definitions

- Application component design including component deployment views, control flows, etc.

- Field equipment deployment architecture

- 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 Maharashtra

- Location of all field systems and components proposed at the junctions,

- Height and foundation of Traffic Signals and Standard Poles for Pedestrian signals.

- Height and foundation of Poles, cantilevers, gantry and other mounting structures for other field devices

- Location of Junction Box

- Location of PoP

- Design of Cables, Ducts routing, digging and trenching

- Electrical power provisioning

The SI shall also identify the customizations/ workaround that would be required for successful implementation and operation of the project.

The feasibility report of the SI shall also include the detailed Technical Architecture which 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 traffic. 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), Software / Application performance. In quantitative terms, there may not be major change in number of Command Centers. However, number of field locations could be even increased over 700 in 5 years' time.

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 bidder 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. Successful bidder 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. There should also be an endeavour to make use of the SSL/VPN technologies to have secured communication between Applications and its end users. The objective is to utilise SSL/VPN technologies for secured communication between Applications and its end users. SI may choose to achieve this functionality though appropriate technical solution.

   Furthermore, all the system logs should be properly stored & archived for future analysis and forensics whenever desired. PSCDCL may carry out the Security Audit of the entire system in approx. 3 months of Acceptance / operationalization through a

Third Party Auditor (TPA), a separate organisation appointed by PSCDCL or it's / PMCs existing consultant.

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. The most appropriate level of security commensurate with the value to that function for which it is deployed must be chosen

c. Access Controls must be provided to ensure that the system is not tampered or modified by the system operators.

d. Implement data security to allow for changes in technology and business needs.

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 growth of the environment.

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. **Inspection –** Client reserves the right to appoint any Third Party Agency during the entire phase of the project

Sub-contracting / Outsourcing shall be allowed only for the work which is allowed as mentioned in the clause with prior written approval of PSCDCL. However, even if the work is sub-contracted / outsourced, the sole responsibility of the work shall lie with the bidder. The bidder 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 PSCDCL.

5.4. Site Clearance obligations & other relevant permissions

5.4.1. Survey and Commencement of Works

Prior to starting the site clearance, the SI shall carry out survey of field locations as specified in **Annexure V**, for buildings, structures, fences, trees, existing installations, etc. The PSCDCL 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 PSCDCL.

5.4.2.   Existing Traffic Signal system

The infrastructure of existing Traffic signal systems including the poles, cantilevers, aspects, controllers and cabling and associated mountings and civil infrastructure may need to be dismantled and replaced with the new systems proposed and shall be in the scope of SI. The dismantled infrastructure shall be delivered at the PSCDCL designated location without damage, at no extra cost.

5.4.3.   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-erected shall be cleaned, provided with new fixings where necessary and the posts re-painted in accordance with PSCDCL guidelines. Road signs, street name plate etc. damaged by the SI during their operation shall be repaired or replaced at the SI's cost.

5.4.4.   Electrical works and power supply

The SI shall directly interact with electricity boards for provision of mains power supply at all desired locations for ATMS field solution. The PSCDCL shall facilitate, if any documentation is required from it's side. SI shall be responsible for provisioning of requisite electricity power and its recurring charges (during operational phase). Bidder may provision the same under appropriate heads in the commercial bid.

5.4.5.   Lightning-proof measures

a.   The Contractor shall comply with lightning-protection and anti –interference measures for system structure, equipment type selection, equipment earthing, power, signal cables laying. The Contractor shall describe the planned lightning-protection and anti –interference measures in the feasibility report.

b.   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 functions; capable to bear certain mechanical external force.

c.   Signal separation of low and high frequency; equipment protective field shall be connected with their own public equal power bodies; small size/equipment signal lightning arrester shall be erected before the earthling.

d.   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.

e. Data line protection shall be installed as per zone defined in IEC 62305.

   i. Type 1 device shall be installed between zone 0B and zone 1.

   ii. Type 2 devices shall be installed before the equipment in zone 2 and 3.

5.5. Design, Supply, Installation and Commissioning of the Field Equipment

The Scope includes Supply, Installation, commissioning and Customization (as required) of various filed systems which include Adaptive Traffic Control System(ATCS) at Traffic Junctions, Traffic Surveillance Cameras, Variable Message Signs, Red Light Violation Detection system, E-Challan System and other IT infrastructure required for successful operation of the ATMS modules.

Based on the approved feasibility report, the SI will undertake the system configuration and customization in line with the changed, improved or specific requirements of Pune Traffic Police, PSCDCL including:

a. The implementation methodology and approach has to be based on the global best practices in order to meet the defined Service Levels during the operation.

b. Best efforts have been made to define major functionalities for each sub- system of ATMS. However, Supplier 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.

c. The SI 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.

d. Finally approved/accepted solution for each component of ATMS shall be accompanied with "System Configuration" document and the same should be referenced for installation of ATMS at Junctions that are identified within the scope of this project.

e. The system integrator 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.

f. The SI shall be responsible for obtaining all permits and approvals necessary to install the ATMS components as per the approved design. The scope of work for installation, commissioning and customization of major components of ATMS is given below.

The sub-components included as part of the project for which field equipment needs to be deployed and integrated are:

5.5.1. Adaptive Traffic Control System (ATCS)

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

a) **Preparation of Project Blueprint:** The SI shall study the existing traffic management systems and processes deployed by the competent authorities, MIS reporting requirements, problem areas and expectations of Pune Traffic Police.

b) **Conduct a survey** of existing traffic operating conditions and movements across all required junctions to:

   i. Collect data of existing operating conditions, traffic volumes across various time periods of a day, which will cover all peak and non-peak hours, weekends, etc., saturation flow rates, on individual lanes, free flow travel time through the junction and actual travel time in peak operating conditions.

   ii. Journey time surveys for As-Is conditions should be conducted along designated corridors which should be designed such that all junctions are picked in at least one corridor. For major junctions, both directions (e.g east-west and north-south) and key turning movements should also be covered. Bidders may propose alternate methodology for collecting travel time survey along all major corridors and junction delays at each of the junctions.

   iii. The System Integrator shall identify the customization or additional installations needed to deploy a standardized ATCS solution as per the functional requirements mentioned in this RFP and submit a document on the Gap analysis/ customization requirements.

c) **Design, Implementation, Customization, Integration with existing Systems & Maintenance of Adaptive Traffic Control System**

   This shall consist of following activities:
   i. Preparation of Solution Architecture and Gap Analysis as per project blueprint to develop a final BOQ for installation.

   ii. Installation of vehicle detectors, controllers, Traffic light aspects, poles, cantilevers and other required accessories for successful operation of the ATCS for PSCDCL, Pune Traffic Police

   iii. Installation of ATCS software application as per the functional requirements specified by PSCDCL, Pune Traffic Police.

   iv. Procurement and supply of requisite licenses (Commercial off the shelf - COTS) software required for successful functioning of the ATCS sub module.

   v. Integration of ATCS infrastructure with existing traffic applications

vi.   Configuration of traffic signal at each of the junction along with development of signal control plan for individual operations, coordinated signal plan for the junction in sync with the area wide signal plan for different operating conditions. The operating conditions may include different peak and off-peak conditions, special events, contingency plans etc.

vii.   Third Party Audit of the ATCS implementation and its performance evaluation as per SLA's defined in the RFP.

5.5.2.   Variable Message Sign Boards

a. These VMS boards will have different characteristics depending upon the location and purpose of installation. VMS board displays are to be controlled by Pune Traffic Police personnel from the TCC. The purpose of the VMS boards is to provide the commuters with information about traffic conditions and alternate routes in case of high traffic on roads.

a. The SI, in consultation with Traffic Police can propose alternate locations apart from the locations mentioned in this RFP for installing the VMS boards where their effectiveness in communicating information about traffic conditions in Pune will be maximized.

b. Pune Traffic Police will review and approve the proposed locations. The Contractor will install the VMS boards on the approved locations.

c. For more details on technical and functional specifications of VMS, the bidder should refer to Annexure II and Annexure III for functional requirements and technical specifications

5.5.3.   Red Light Violation Detection (RLVD) System

a. The SI will install the RLVD Systems at approximate **33** junctions across the city. This system will capture the infractions of Red light and stop line violations at these junctions.

b. The SI will 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 will be installed by the contractor. The contractor will 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 will make the final connections to the camera.

c. The solution proposed by the SI shall have the capability to seamlessly integrate with the EChallan system proposed as part of this project.

d. The SI shall be responsible for providing all the necessary IT infrastructure for analysis, storage & retrieval of the infraction information at TCC or any other location as specified in the RFP.

e. For more details on technical and functional specifications of Red Light Violation Detection (RLVD) system, SI should refer to Annexure II, and Annexure III for Functional and Technical specifications respectively.

5.5.4.   eChallan System

a. The SI will design, supply, and configure the E-Challan system to automatically generate traffic challans based on infractions received from the installed RLVD systems. The system will be operated by the traffic police personnel at the TCC using client workstations and field officers through handheld devices.

b. The operator for the eChallan system shall reside at the remote location, typically at the TCC from where the back office operations for verification of traffic violation (Including RLVD) can be undertaken. Once the traffic challan has been generated it will be available in the system to authorized personnel for viewing and printing at remote location.

c. As part of the system, the SI will also provide a hand held device capable of connecting with the eChallan server for on the spot challan and printing of receipt.

d. The SI shall ensure that the proposed system has the capability for manual verification and complete automation of the Challan/ notice processing/ printing process. This shall involve automatic capturing of relevant information from the evidence generated by the traffic enforcement system and integrating it with the vehicle database (Vaahan Sarathi, any other database) being available with Pune Traffic Police or the transport department and issuing a notice.

e. The functional and technical specification details of the eChallan system are provided at Annexure II and Annexure III of this Volume.

5.6.   Design, Supply, Installation and Commissioning of Network & Backbone Connectivity for ATMS

a. Network & Backbone Connectivity is one of the most important components 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.

b. The SI 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 TCC. All the components of the technical

network architecture should be of industry best standard and assist bidder in ensuring that all the connectivity SLAs are adhered to during the operational phase.

c. The SI 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 75% of the proposed last mile connectivity should be wired. Last Mile to be defined as "the access link from the service provider's PoP – (as per Telco Standards) to the field device".

d. A combination of network technology including leased lines, OFC Network, Terrestrial Networks, Wireless broadband, VSAT and Mobile Network technologies is expected to be used to provide seamless connectivity to all field devices. Connectivity to Data Centers and TCC shall be provided with scalable capacities to allow for expansion in the future. Bidder shall be allowed to procure bandwidth related services from multiple Telecom Service Providers.

e. Bidders shall consider the 2G/3G/4G GPRS connectivity based on the available technology and service quality in the city of Pune for connectivity of eChallan hand held devices with DC at TCC.

f. Bidders are also required to do the estimation of bandwidth requirements considering following benchmark parameters:

#	ATMS component	Minimum Consideration
1	ATCS	• Minimum 1 MB per controller
2	RLVD	• 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
3	Variable Message Sign Boards	• Minimum 1 MB for each location

g. The actual bandwidth requirement to cater the above mentioned bandwidth parameters and to meet SLAs would be calculated by the bidder and the same shall be clearly provisioned in the technical proposal with detail calculations. PSCDCL also requires the bidder to meet the parameters of video feed quality, security & performance and thus bidders should factor the same while designing the solution. PSCDCL reserves its right to ask the Sy stems 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.

h. Bidders are required to estimate the bandwidth requirement for connectivity between TCC and Remote Data backup site at Smart City Command Center or any other location to be informed by PSCDCL at a later stage, based on the connectivity requirement. The acceptance of the solution would be subject to the proposed networking solution achieving the service level requirements of the PSCDCL. The bandwidth provisioned needs to adhere to the following minimum benchmark requirements –

- Latency should be less than 40 ms

- Jitter should be less than 10% of one-way latency

- Packet loss should be less than 0.5%

i. In case the Telecommunication guidelines of Government of India require the purchaser to place Purchase Order to the Service Provider for bandwidth, PSCDCL shall do so. However, Systems Integrator shall sign a contract with Telecom Service Provider(s) and ensure the performance. PSCDCL shall make payments to the Systems Integrator.

j. The system integrator 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.

k. RI & RoW shall be waived off for only the last mile connectivity to the project locations. Additional RI/ RoW chargeable as per prevailing conditions. No exclusive rights of RI/ RoW shall be given to the SI.

5.7. Supply, Installation and Commissioning of IT Infrastructure at DC, DR and at TCC

a. It is proposed that the SI shall provide the Rack and the IT Infrastructure (Networking, Compute and Storage) at the DC location provided by PSCDCL and Backup Storage at DR location. Primary Data Center shall be at the Smart City Operation Center building, buing built by PSCDCL. DR location shall be at TCC.

b. In case the physical construction of the Smart City Operations Center Building gets delayed, SI shall temporarily host the Rack & IT Infrastructure of Data Center at the PMC's Cloud Service Provider.

c. Hosting charges for the same shall be borne by PSCDCL. The same shall be migrated by the SI to the Smart City Operations Center Building, once the building is ready for operations.

d. Bidder shall also provision for the requisite bandwidth at DC, DC and TCC.

e. The SI shall provide system integration services to customize and integrate the applications procured through the projects. The ATMS applications proposed by the SI 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

f. The bill of material proposed by the successful bidder will be approved by PSCDCL for its supply and installation. Indicative IT Infrastructure to be commissioned as part of the ATMS project at Data Centers are as under:

   i. Servers (inclusive of OS)

   - Application Servers

   - Database Server

   - Management Server

   - Enterprise Backup Server

   - Domain Controller

   - Failover Servers for application and Recording Servers

   - Any other Server required to the cater to the scope of work mentioned in this

   ii. Application & System Software for

   - ATCS application

   - Red Light Violation Detection application

   - Variable message Sign Board application

   - eChallan application

   - RDBMS (if required)

   - Anti-virus Software

   - EMS software

   - Customised Software to cater to requirements of Project Requirements

   iii. Other systems

   - Primary Storage Solution

   - Backup / Secondary Storage Solution

   - Storage Management Solution

   - Router

   - Switches (L2 & L3 Switches)

- Racks (as per requirement)

- All required other Passive & Network Components

g. The above are only indicative requirements of IT & Non-IT Infrastructure requirements at data centres. The exact quantity and requirement shall be proposed as part of the technical proposal of the bidder

h. The SI shall also establish a state of the art Traffic Command Center at the location provided by PSCDCL, the key components of the TCC will be as follows:

 i. Video wall
 ii. Operator workstations
 iii. Network printer
 iv. UPS (1 hour backup)

i. Benchmark specifications for various items mentioned above are given in the Annexure to this RFP document.

5.8. Preparation and implementation of the Information security policy, including policies on backup

The SI shall prepare the Information Security Policy for the overall Project and the same would be reviewed and then finalized by PSCDCL & its authorized committees. The Security policy needs to be submitted by the System Integrator within 1st quarter of the successful Final Acceptance Tests.

The Systems Integrator should then obtain ISO 27001 certification for all the Traffic Command Center and the Datacenter within 2 quarters of Final Acceptance Test. Payment from 3rd Quarter onwards shall be withheld till this certification is obtained by the SI.

5.9. Capacity Building and Training

Capacity Building is an important aspect of this Project, the PSCDCL and Traffic Police expects the SI to undertake it in a very professional manner. SI has to conduct a proper training need analysis of all the concerned staff and draw up a systematic training plan in line with the overall Project plan. For all these training programs the Bidder has to provide necessary course material and reference manuals (user/maintenance/ administration) along with training schedules for all phases. The training shall held at various office/department locations as finalised by PSCDCL and Traffic Police Department.

Trainings would be of three types for different phases of the Project:

1. **Functional Training:** This training would focus on the use of the software of the various ATMS components at Traffic Command Center, so that the users are aware of all the operations of the ATMS and are able to implement the overall process defined

by the Police Department for optimum use of the system. Broad training requirement defined for the purpose of calculation of effort is as follows:

- Training program of 1 batch (of 20 personnel) of 2 days every 2 months

- Expected training time of 24 hours (3 days of 8 hours each)

2. **Administrative Training:** This training would focus on the administration of ATMS solution and server infrastructure and would be imparted to about 8 – 10 staff identified by the PSCDCL for administration of the system from PSCDCL's side. SI shall also provide additional training programme of 1 batch (of 8 - 10 personnel) of 5 days every 6 months. Expected training time would be 40 hrs (5 days of 8 hrs each).

3. **Senior Management Training:** This training would focus on how to use the ATMS for day-to-day monitoring by the Sr. Management and access various exception reports. Broad training requirement defined for the purpose of calculation of effort is as follows:

- Initial Training of approx. 40 officers (i.e. about 4 batches of 10 officers each)

- Additional training programme of 1 batch (of 10 personnel) of 2 days every 3 months

- Expected training time of 8 hrs

Note: Additional Training requirements will be assessed by PSCDCL along with SI when such requirements arise.

Other requirements to be fulfilled by the SI with respect to training are as follows:

1. Prepare the training material in consultation with PSCDCL & its authorized committees. Detailed training manuals would be prepared by the SI prior to the start of the training. Master copies of all training material should be submitted to the Authority for approval.

2. One Hard Copy & One Soft Copy of the training material shall be given by the SI to all the trainees. The location for the Administrative & Sr. Management Training would be decided subsequently.

3. Successful Bidder should ensure that the knowledge transfer to the staff identified by PSCDCL happens effectively post training.

5.10. Acceptance Testing

The PSCDCL and Traffic Police shall review and finalize the detailed acceptance test plan (FAT) proposed by the bidder. The PSCDCL and Traffic Police would also conduct audit of

the process, plan and results of the Acceptance Test carried out by the SI for both IT & non-IT components. The PSCDCL and Traffic Police would issue certification of completion for which PSCDCL and Traffic Police shall verify availability of all the defined services as per the contract signed between the SI, PSCDCL and Traffic Police. The SI shall be required to demonstrate all the services, features, functionalities as mentioned in the agreement.

All acceptance testing, project review and monitoring shall be enabled through a Project Management Unit (PMU) nominated by PSCDCL and Traffic Police prior to certification by PSCDCL and Traffic Police.

Commissioning shall involve the completion of the site preparation, supply and installation of the required components and making the Project available to the PSCDCL and Traffic Police for carrying out live Operations and getting the acceptance of the same from the PSCDCL and Traffic Police. Testing and Commissioning shall be carried out before the commencement of Operations.

5.10.1. Partial Acceptance Testing

Partial Acceptance Test shall involve scrutiny of documents for various IT / Non-IT components to verify if the specifications conform to the technical and functional requirements mentioned in the Tender and subsequent corrigendum. PSCDCL reserves right to conduct physical inspection of the equipment delivered to ensure that they arrive at the sites in good condition and are free from physical damage and incomplete shipments and shall return the products to the supplier at the supplier's expenses if required quality is not maintained. Physical inspection of hardware will also include physical checking and counting of the delivered equipment in presence of the Successful Bidder. This equipment will only be acceptable as correct when each received item corresponds with the checklist that will be prepared by the Successful Bidder prior to shipment. Any shortfalls in terms of number of items received may render the delivered equipment incomplete.

5.10.2. Final Acceptance Testing

The final acceptance shall cover 100% of the PUNE ATMS Project, after successful testing by the PSCDCL and Traffic Police or its PMU; a Final Acceptance Test Certificate (FAT) shall be issued by the PSCDCL and Traffic Police to the SI.

Prerequisite for Carrying out FAT activity:

i. Detailed test plan shall be defined by the PSCDCL and Traffic Police. This shall be submitted by SI before FAT activity to be carried out.

ii. All documentation related to PUNE ATMS Project and relevant acceptance test document (including IT Components, Non IT Components etc.) should be completed & submitted before the final acceptance test to the PSCDCL and Traffic Police.

iii. The training requirements as mentioned should be completed before the final acceptance test.

iv. Successful hosting of Application, NMS and MIS Software.

v. For both IT & Non-IT equipment's / software manuals / brochures / Data Sheets / CD / DVD / media for all the PUNE ATMS Project supplied components.

The FAT shall include the following:

i. All hardware and software items must be installed at respective sites as per the specification.

ii. Availability of all the defined services shall be verified.

iii. The SI shall be required to demonstrate all the features / facilities / functionalities as mentioned in the RFP.

iv. The SI shall arrange the test equipment required for performance verification, and will also provide documented test results.

v. The SI shall be responsible for the security audit of the network to be carried out by a Certified third party as agreed by PSCDCL and Traffic police.

Any delay by the SI in the Final Acceptance Testing shall render him liable to the imposition of appropriate Penalties. However, delays identified beyond the control of SI shall be considered appropriately and as per mutual agreement between PSCDCL and SI. In the event the SI is not able to complete the installation due to non-availability of bandwidth from the bandwidth service providers, the Supplier and PSCDCL and Traffic Police may mutually agree to redefine the Network so the SI can complete installation and conduct the Final Acceptance Test within the specified time.

5.11. System Documents and User Manuals

The SI shall provide documentation, which follows the ITIL (Information Technology Infrastructure Library) standards or IEEE/ISO Acceptable Documentation Standards. This documentation should be submitted as the project undergoes various stages of implementation and provide all traceability documentation on changes done on the IT components during the course of the implementation of the solution.

Indicative list of documents include:

- **Project Commencement**: Project Plan in MS Project giving out micro level activities with milestones & deadlines.

- **Delivery of Material**: Original Manuals from OEMs.

- **Training**: Training Material will be provided which will include the presentations used for trainings and also the required relevant documents for the topics being

covered.

- **Process Documentation**: The bidder shall be responsible for preparing process documentation related to the operation and maintenance of each and every component of the PUNE ATMS Project. The prepared process document shall be formally signed off by PSCDCL and Traffic Police before completion of final acceptance test.

    a. The selected bidder shall document all the installation and commissioning procedures and provide the same to the PSCDCL and Traffic Police within one week of the commissioning of PUNE ATMS.

    b. The Selected bidder shall submit a complete set of Single Line diagram, a complete cabling system layout (as installed), including cable routing, telecommunication closets and telecommunication outlet/ connector designations. The layout shall detail locations of all components and indicate all wiring pathways.

    c. Manuals for configuring of switches, routers, etc shall be provided by the selected bidder.

The selected bidder shall be responsible for documenting configuration of all devices and keeping back up of all configuration files, so as to enable quick recovery in case of failure of devices.

5.12. Operations and Maintenance for a period of 5 years

Success of the Project would lie on how professionally and methodically the entire Project is managed once the implementation is completed. From the System Integrator perspective too this is a critical phase since the quarterly payments are linked to the SLA's in the post implementation phases. System Integrator thus is required to depute a dedicated team of professionals to manage the Project and ensure adherence to the required SLAs. SI shall provide operations and maintenance services for the software, hardware and other IT and Non-IT infrastructure installed as part of ATMS project for a period of 5 years.

The SI shall setup a central helpdesk dedicated (i.e. on premise) for the Project, which shall be supported by their field units, proposed to be setup at TCC. This helpdesk would be operational upon implementation of the Phase I of the Project.

Indicative key resource requirement for overall management of the Project is as follows:

#	Role	Min. Qualification & Experience
1	Project Director	▪ BE / BTech. (with Masters Degree preferred) ▪ 15+ Years of Experience

#	Role	Min. Qualification & Experience
		▪ 10+ Years of experience in large project management ▪ Should have experience of minimum 1 assignment of implementation of Adaptive Traffic Management System in India / globally
2	Project Manager #	▪ BE / BTech. + MBA / MTech ▪ 10+ Years of Experience ▪ 5+ Years of experience in large SI project experience ▪ Minimum 1 large similar (similar to Pune ATCS Project) project experience
3	Technical Expert- Traffic Command Center	▪ BE / BTech ▪ Experience of 3+ Years in Command and Control Center
4	Technical Expert- Transport Engineering #	▪ Graduation / Post Graduation in Transportation ▪ Minimum 10+ Years of total Experience ▪ Minimum 5+ Years of experience in Transportation domain ▪ Should have experience of atleast one project in design of actuated signal control with vehicle detection capability ▪ Experience in Real time information systems and ITS would be added advantage
5	Technical expert- Intelligent Transport Systems #	▪ BE / BTech ▪ Minimum 10 years of experience, Min. 5 years of experience in transportation domain ▪ Should have experience of atleast one project in design implementation of Intelligent (preferably Adaptive) Traffic Management System ▪ Should have experience in real time adaptive traffic control systems (on the product quoted by the bidder) ▪ Experience in setting up Command and Control Centre would be added advantage
6	Technical Expert – Network #	▪ BE / BTech. ▪ Minimum 10 years of experience, Min. 5 years of experience in IT Networks ▪ Should have experience of atleast one project in design implementation of large IT Network for similar project ▪ Certification in Networking would be added advantage
7	Technical Expert – Security	▪ BE / BTech. ▪ 5+ Years of Experience in IT Security
8	Technical Expert – Server & Storage	▪ BE / BTech. ▪ 5+ Years of Experience in Server Management

#	Role	Min. Qualification & Experience
9	Technical Expert – VMS #	▪ Graduate ▪ Minimum 10 years of experience, Min. 5 years of experience in VMS domain ▪ Should have experience of atleast one project in design implementation of Variable Display Messaging Signs, with centralized management
10	TCC Supervisor cum co-ordinator (in 3 shifts)	▪ Graduate ▪ Minimum 3 years of experience in supervisory role in large projects
11	Field Engineers (required numbers to meet SLAs)	▪ Graduate ▪ Minimum 2 years of similar experience
12	HelpDesk Staff (in min. 2 shifts)	▪ Graduate ▪ Minimum 2 years of similar experience

These resources are required to be deployed on full-time basis (both for implementation and operations cum maintenance phases). Bidder shall be levied penalty for any short-deployment of these resources as per SLAs defined. Other resources specified are indicative in nature and Bidder would need to provision sufficient resources (above mentioned roles + additional roles) in order to meet SLAs.

Some of the key services to be provided by the SI in post-implementation period are as follows ::

▪ Ensure availability of the PUNE ATMS infrastructure (both physical and IT) including but not limited to Power, Cooling, Racks, Storage and other peripheral equipment as per the SLAs.

▪ Ensure scalability in terms of availability of racks and supporting infrastructure.

▪ 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 SI.

▪ 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).

▪ Proactive monitoring of the entire basic infrastructure installed.

▪ SI shall maintain records of the maintenance of the basic infrastructure and shall maintain a logbook on-site that may be inspected by the PSCDCL and Traffic Police at any time.

▪ Ensuring that the network is available 24x7x365 as per the prescribed SLAs

- Attending to and resolving network failures and snags.

- Support and maintain the overall network infrastructure including but not limited to LAN passive components, routers, switches etc.

- Configuration and backup of network devices including documentation of all configurations.

- 24x7x365 monitoring of the network to spot the problems immediately.

- 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.

5.13. Hand-over of the system at the end of contractual period along with all documentation required to operate and maintain the system

System Integrator will submit to PSCDCL the following before the expiry of the contract:

1. Information relating to the current services rendered and data relating to the performance of the services; Entire documentation relating to various components of the Project, any other data and confidential information related to the Project;

2. All other information (including but not limited to documents, records and agreements) relating to the products & services related to the project to enable PSCDCL and its nominated agencies, or its replacing Successful Bidder to carry out due diligence in order to transition the provision of the Project Services to PSCDCL or its nominated agencies, or its replacing Successful Bidder (as the case may be).

5.14. Roles and Responsibilities

Agency	Role Description
PSCDCL	• Co-ordination with Police & Transport departments for implementation of the project • Co-ordination with successful bidder for implementation of the project • Signing the Tripartite agreement for executing the project with Traffic Police department and successful bidder • Co-ordination with concerned department(s) to handover the sites to successful bidder • Release payments as per the certification of uptime, down time of signals by • Co-ordination with successful bidder for applying wired / wireless communication connections, power connections. • Monitor the project progress in association with Traffic police department • Payment of the Power bills for all sites. • Conducting pre-bid conference along with department • Receiving and evaluation of the bids • Finalization of the service provider
Traffic Police Department	• Signing the Tripartite agreement for executing the project along with PSCDCL and successful bidder • Conduct / appoint a third party for Acceptance Testing in consultation with PSCDCL. • Appoint a dedicated Project Director in consultation with PSCDCL. Until the Project Director is appointed or as and when the post is vacant, DCP Traffic will be the Project director. • Appoint a dedicated Project Manager / Project Engineer in consultation with PSCDCL. • Monitor the project progress in association with PSCDCL • Forwarding the Certification of uptime, down time of signals to PSCDCL for release of the payments • Phasing of the Sites for implementation in consultation with PSCDCL. • Handing over of the sites to the successful bidder in consultation with PSCDCL. • Provide built-in offices space for the control Room at CP office, and also at control Room • Co-ordination with successful bidder for applying communication (Wired / Wireless) connections, power connections in the name of Traffic Police

Successful Bidder	• Field study to understand the requirements • The successful bidder has to submit the performance guarantee on receipt of award notification. • Fine tune the Project Plan in consultation with the department • Entering into contract with the department • Mobilization of the team and take up the work • Deliver the deliverables as per the contract terms and conditions • Installing and commissioning of the control room & signals and maintain them during the contract period. • Maintain one team with each zone to attend the breakdown maintenance. One team at control room. • Train Traffic police & other concerned departments on use of the system. • The bidder has to remove the existing signals and install new system. • Transferring the existing electricity connection to the name of Pune Traffic police • For new connections, apply for electricity connection in the name of Pune Traffic police and arranging them. • Apply for communication (connectivity) for all locations in the name of Traffic police • Payment of the communication (connectivity) charges during commissioning period, entire operation and maintenance period of 5 years. • Establish radio network of the bidder connecting its Headquarters and control room for effective monitoring. • Payment of the Communication bills for all sites. • Transfer of all the assets created within 30 days from the date of completion of the Acceptance Test through proper sale Invoice. • Maintenance of Generator during the contract period • Customize, Configure, Maintain and updating the application software during the contract period. • Train the identified personnel of Traffic Department on operating and maintaining the complete system. • Deploy experts as indicated under the technical manpower requirements for a period the entire period of operations and maintenance phase who shall provide daily support to TCC operators and handholding. • Prepare quarterly and annual reports on the base line KPIs and the improvements made in the junctions across and the corridors

Payment of Operations and maintenance phase will be made on quarterly basis (at completion of each quarter) based on the adherence to SLA.

6. Implementation and Roll out Plan

The ATMS project requires vast experience, expertise and technical & financial capability by a System Integrator for implementation of the project and to manage proper operation and maintenance. Apart from the technical strength, financial capability plays a major role and needs due diligence for smooth project implementation.

The project has been envisaged to be implemented in two phases, Phase I shall require the design, supply installation and commissioning of the ATMS modules in a selected area of the city, to study the impact of the deployed systems. The area under consideration for the pilot project will consist of about 120 traffic junctions, however the final list of junctions and area to be considered will be finalized by PSCDCL, Pune Traffic Police and the successful bidder.

Furthermore, Phase 2 would cover supply, installation and commissioning of the ATMS modules on the remaining junctions and additionally, customize and configure the system based on learning's of the phase I phase.

The following table gives the details of the phases, timelines and deliverables that the SI shall adhere:

Sl No	Time line (in weeks)	Adaptive Traffic Management system Activity	Capacity Building/ Training	IT Infrastructure Implementation	Deliverables
	T	Signing of Contract			Performance Bank Guarantee
1	T+3	Project Kick Off – This scope element requires the SI to undertake the following as part of kick off and mobilization. 1. Confirm scope of project and prepare the engagement brief 2. Prepare a Strategy and Assess Stage plan 3. Select required Programme management procedures, standards, methods, tools 4. Preparation of quality Plan 5. All final deliverables will be finalized in consultation with the client and agreed including project implementation plan and deployment schedule of resources			1. Project charter 2. Project Implementation Plan 3. Work Breakdown Structure 4. Quality Management plan 5. Risk Management and Mitigation Plan 6. Migration plan 7. Resource Deployment Plan 8. Stakeholder management plan 9. Communication plan 10. Change management plan 11. Escalation management plan

			12. Exit management plan

Scoping and Feasibility study Phase

2	T+10	The SI shall be responsible for: • Field study for finalization of detailed deployment architecture and project plan • SI to carry out Site Survey for each junction for junction Design (Civil Works) and build drawings of all Junctions • Analyze the current traffic conditions and establish base line values for traffic management parameters like junction behavior, average stoppage time, average speed per lane, average travel time etc. • Development of traffic management plans for individual signal controls and groups of signal controllers along with pre-planned intervention strategies for special scenarios • Studying the design architecture, carrying out site survey and finalize the distribution, exact position of the various systems and its components • Identify the buildings, structures, fences, trees, existing installation, that are to be removed/ relocated for installation of the various systems and its components • Identifying the variation to be made to the existing list of locations if any. • Identification of existing infrastructure that can be utilized if any. • Placing survey markers at all locations of installations, showing them on the engineering drawings, checking accuracy of their position, coordinating them with PSCDCL, Traffic Police or any third party agency designated by the PSCDCL	1. Field Report including the drawings of all junctions with finalized BoQ, submitted to general consultant for validation and sharing with the Transport SME, PSCDCL and Traffic Police department for approval 2. Roll out plan for each system and its components, which will include implementation phases, migration plan, and acceptance testing plan. 3. Final List of equipment including current infrastructure reusability report (If applicable) 4. Engineering drawing submittals 5. Detailed integration requirements 6. Functional, System Requirement Specification Report and Software Requirement Specification reports meeting all the Business, Functional and technical requirement of PSCDCL and incorporating

					all the functional specifications, standards provided by the PSCDCL and different integration points with external agencies and other applications. • Application customization report • System design documentation describing the logical security architecture design, Physical security architecture design
4	T+13	• Approval of Site survey report, implementation strategy and Pilot project Plan • Completion of permissions from other agencies • Design for integration with other external applications • Initiation of helpdesk setup	• Change Management & Capacity Building Plan • Change Readiness Assessment • Orientation to ATMS and its benefits to officers of the rank of TI and below • Change Mgmt & Communication Workshop for TI and below • Project Management trainings for DCP and above	• Infrastructure Sizing Report & Deployment Plan • Validation of IT Infrastructure requirements* • Final Bill of Material (BoM) with Technical specifications for the ATMS field equipment like camera, sensors etc., IT Hardware, Network and other IT Infrastructure Requirements • Strategy for all Traffic Centre's Hardware procurement & Deployment plan • Procurement of IT infrastructure & field devices (PO issued by SI) • Site preparation for pilot locations	• Report on Approach for Capacity Building &Tools/ Formats for evaluation of capacity building measures • Capacity Building Plan • Change Management Strategy • Detailed plan for change management • Communication plan • Documentation on approved & procured IT Infrastructure and proposed control centre sites To-Be Process Document (Final Solution Blueprint) • Final BoM • Change Management workshops completion Report • Knowledge Transfer Plans • Report on strategy for helpdesk setup & operations

Phase I- Deployment Phase					
5	T+18	• Deployment of field devices for ATMS • Procurement and supply of requisite licenses (Commercial off the shelf - COTS), Installation and implementation (including configuration/ customization and Testing)Completion of ATMS application customization	• Preparation of training Curriculum and training materials • Role based training on ATMS application for pilot locations • Training on ATMS core Modules functioning and back office operations • Traffic Command Centre & Network Administration training	• Network Communication Backbone establishment • Site preparation for TCC • Infrastructure setup for Phase I locations • IT Infrastructure Installation at DC, and TCC	• IT Infrastructure Installation Report with user manuals • Field devices installation Report with user manuals • Application Test Plan and Test Cases • Report on amendments / enhancements / modifications made in ATMS applications based on inputs from Pune Police, PSCDCL • Phase I Acceptance from PSCDCL and Pune Police • Overview Training Completion report • Training material
Testing					
6	T+20	• Application testing including unit testing, system integration testing, user acceptance testing, performance testing (Full Load, Stress test) and Security and access control testing etc. • Site specific system testing		• Partial Acceptance Testing (PAT) of the IT Infrastructure and Network Connectivity performance of TCC site. • Preparation of IT Infrastructure System manual	• PAT report and Factory Testing Report • PAT Report on IT Infrastructure (TCC and all locations) • Network connectivity Test Report • IT Infrastructure System Operation Manual • IT Infrastructure Maintenance and Troubleshooting Manual • Site specific test plans and test scripts for each installation site in the region • Overall test report

Phase I- Go-Live

| 7 | T+26 | • Phase I- Go-live
• Commencement of Handholding for Pilot locations
• Help desk Setup Go-Live | • Role based training on ATMS application for pilot locations
• Training on ATMS core modules/TCC functioning and back office operations for phase I locations
• Management Information System/Reporting training to DCP and above
• Regional Traffic Management Control Centre & Network Administration training
• Teamwork and Communication skills training | • Implementation of ATMS System at pilot locations and other System Software including Help Desk | • Report on module specific role based training on ATMS (trainees attended, pass/fail status etc.)
• IT Infrastructure Installation Report for phase I locations
• Phase I Go-Live Report including
  o Site Preparation and Infrastructure Deployment / Commissioning Report for Data Centre
  o Help desk centre operations
  o Issues faced during installation alongwith their remedies |

Phase I- ATMS Stabilization Phase

| 8 | T+32 | • ATMS stabilization post Phase I
• Completion of Changes required post Phase I Go-Live
• Third Party Audit for Phase I locations. | • Continuation of End user training for users selected in phase I | | • Phase I learning and customization completion report
• Report on amendments / enhancements / modifications made based on inputs of PSCDCL, Pune Police / Third Party's Acceptance Testing for complete Roll-Out
• Go-Live Acceptance from PSCDCL, Pune Police |

					• Deployment report for Handholding support to phase I Location • Finalize integration strategy for TCC,

Deployment Phase for Remaining locations- Phase II

11	T+36	• Deployment of field devices for ATMS • Completion of ATMS application customization • ATMS integration plan • ATMS application testing plan	• Change management Training • Preparation of training Curriculum and training materials • Role based training on ATMS application for all locations • Training on ATMS core modules/TCC functioning and back office operations for remaining locations • TCC & Network Administration training • Preparation of end user manual	• Network Communication Backbone establishment • IT Infrastructure Installation at TCC, DC • Infrastructure setup for Phase II locations	• IT Infrastructure (TCC, and DC Installation Report • Overview of Training Completion report • Training plan and schedule • Training material • Application Test Plan and Test Cases • Report on amendments / enhancements / modifications made based on inputs of PSCDCL, Pune Police • Deployment phase acceptance from PSCDCL, Pune Police • Integration test plan • Report on module specific role based training on ATMS (trainees attended, pass/fail status etc.)

Testing of overall System at all locations

13	T+39	• Application testing including unit testing, system integration testing, user acceptance testing, performance testing (Full Load, Stress test) and		• Partial Acceptance Testing of the IT Infrastructure and Network Connectivity performance of TCC and DC. • Preparation of IT Infrastructure System manual	• PAT report, User Acceptance and Factory Testing Report FAT Report on IT Infrastructure (TCC and all locations) • Network connectivity Test Report

		• Security and access control testing etc. • Site specific system testing			• Site specific test plans and test scripts for each installation site in the region • IT Infrastructure System Operation Manual • IT Infrastructure Maintenance and Troubleshooting Manual
Final Go Live				
14	T+52	• Go-live • Commencement of Handholding for all locations • Completion of ATMS integration with external agencies	• Continuation of role based end user training	• Implementation of ATMS System at all location and other System Software including Help Desk	• IT Infrastructure Installation Report for all locations • Go-Live Report • Go-Live Acceptance from PSCDCL, Pune Police • End User Training Completion Report
ATMS Stabilization Phase				
15	T+58	• ATMS stabilization post Go-Live • Third Party Audit for project • Completion of Post implementation analysis			• Third party audit report • Analysis report giving comparisons with Base line traffic parameters as established during study phase
16		• Continuation of handholding programme	• Completion of Training to IT Core Team • IT Infrastructure Security Training • Data Centre & Network Administration Training Hardware component Monitoring and maintenance Training Completion of end user training for all phases		1. Training Completion reports on: o IT Infrastructure o DC, Network Administration o Hardware component installation and administration

				2. Following Final Reports on ○ Approved Access Control and Authorization Policy for Pune Police, PSCDCL ○ Final Report on the Access rights and control structure ○ Final report on ATMS Configuration/ customization for all modules ○ End User Manual for ATMS field installations, system installations ○ End user training completion report ○ ATMS integration completion report ○ End user manual report ○ Completion of handholding report ○ People deployed in Command Control centers and Helpdesk
Post Implementation Phase- Operations and Maintenance Phase				
17	5 Years from date of final go live	• SLA and Performance Monitoring Plan • Project Operate and Review Logging, tracking and resolution of issues. • Training curriculum updates corresponding to updates/modifications to ATMS modules		• Detailed plan for monitoring of SLAs and performance of the overall system • Fortnightly Progress Report on Project including SLA Monitoring Report and Exception Report • Details on all the issues logged

			- Quarterly reports on the Base Line parameters/ KPIs established improvements thereafter - Annual analysis report giving comparisons with Base line traffic parameters/ KPIs as established during study phase - Training to end users on any system upgrade

7. Annexure I- 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. Bidders are required to undertake their own requirement analysis and may propose higher specifications that are better suited to the requirements.

2. Any manufacturer and product name mentioned in the Tender should not be treated as a recommendation of the manufacturer / product.

3. None of the IT / Non-IT equipment's proposed by the Bidder 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.

4. All IT Components should support IPv4 and IPv6

5. Technical Bid should be accompanied by OEM's product brochure / datasheet. Bidders should provide complete make, model, part numbers and sub-part numbers for all equipment/software quoted, in the Technical Bid.

6. Bidder should ensure that only one make and model is proposed for one component in Technical Bid for example all PTZ cameras must belong to a single OEM and must be of the same model etc.

7. Bidders 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.

8. All equipment, parts should be original and new.

9. The user interface of the system should be a user friendly Graphical User Interface (GUI).

10. Critical core components of the system should not have any requirements to have proprietary platforms and should conform to open standards.

11. 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 PSCDCL.

12. All the Clients Machines / Servers shall support static assigned IP addresses or shall obtain IP addresses from a DNS/DHCP server.

13. The Successful Bidder should also propose the specifications of any additional servers / other hardware, if required for the system.

14. The indicative architecture of the system is given in this volume. The Successful Bidder must provide the architecture of the solution it is proposing.

15. 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.

16. 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.

17. SI 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.

18. All the hardware and software supplied should be from the reputed Original Equipment Manufacturers (OEMs). PSCDCL 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.

19. **For Servers, Active Networking Components, Security Equipment and Storage Systems proposed:** OEMs should be amongst the top 5 World-wide Market share in terms of Revenue as per Gartner / IDC latest published quarterly report. Bidder is expected to attach the report along with the technical proposal.

20. Cameras 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. All licenses should be in the name of the PSCDCL.

8. Annexure II- Functional requirements

Functional requirements of the Adaptive Traffic Control System

8.1. Adaptive Traffic Control System

The Adaptive Traffic Control System has the following building blocks.

- A.   Traffic Signal Controller

- B.   Vehicle Detectors

- C.   Communication Network

- D.   ATCS Application Software

- E.   Traffic Management Centre

8.1.1.   Traffic Signal Controller

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 programme 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.

The Traffic Signal Controller will be adaptive so that it 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.

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.

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.

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 10 sec per day.

The controller shall have the facility to update the RTC time from ATCS server, GPS and through manual entry.

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

The controller shall provide the following facilities in a separate panel with provision for lock and key arrangements for use by the Traffic Police.

- 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.

- One Forced Flash Switch: Activation of this switch should force the signal to Flashing Amber / Flashing Red.

- 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.

- 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.

- 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.

B) Modes of Operation

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

- **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.

- **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.

- **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.

- **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.

- **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.

- **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 to be carried out for all demand actuated stages except for Priority Stage.

- **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.

  The traffic signal controller shall accept commands for remote selection / de-selection of the following from the Central Computer at TMC.

    - Hurry Call

    - Flashing Amber / Flashing Red

    - Junction Off

  If not reverted to the normal operation within the time period listed below, the traffic signal controllers shall timeout the commands and operate normally

- Hurry Call – 5 Minutes

- Flashing Amber / Flashing Red – 30 Minutes

- Junction Off – 30 Minutes

The traffic signal controller shall report the following to the Central Computer through the communication network every cycle or on an event as appropriate.

Green time actually exercised for each approach (stage preemption timing) against the Green running period set for the approach by the Central Computer

Mode of Operation

- Lamp failure, if any

- Output short circuit, if any

- Detector failure, if any

C) Traffic Signal Controller Operating Parameters

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

- 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.

- The pedestrian phase signal shall be configured for flashing red or flashing green aspect during pedestrian clearance.

- It shall be possible to configure any phase to the given lamp numbers at the site.

Stages – The controller shall have facility to configure 32 Stages.

- 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.

- 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.

- Special Day Plans – The controller shall have facility to configure a minimum of 20 days as special days in a calendar year.

- 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.

- 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.

- 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.

- 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.

- Signal lamps monitoring – The controller shall have inbuilt circuitry to monitor the lamp status

- 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.

- 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.

- Fixed Time mode with fixed offsets

- Vehicle Actuated mode with fixed offsets

D) Input and Output facilities

- **Lamp Switching:** The controller shall have minimum 64 individual output for signal lamp switching, configurable from 16 to 32 lamp groups where in each group is RED, AMBER & GREEN. The signal lamps may be operating on appropriate DC/AC voltage of applicable rating

- **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.

- **Communication Interface:** The traffic signal controller shall support Ethernet interface to communicate with the ATCS server

- **Power Saving:** Bidders are requested to propose appropriate energy saving mechanisms and approaches. The traffic signal controller shall have a facility to regulate the intensity of signal lamps during different ambient light conditions.

- **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.

    o The traffic signal controller shall update the date, time and day of the week automatically from GPS during power ON and at scheduled intervals.

    o Manual entry for date, time and day of week shall be provisioned for setting the traffic signal controller RTC (Real Time Clock).

    o It shall be possible to set the RTC from the Central Server when networked.

- **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

- **Operator Display (optional):** The traffic signal controller shall optionally have a LED backlit Liquid Crystal Display (LCD) as the operator interface.

8.1.2. Vehicle Detector

The bidder shall propose appropriate technical solution / product to count vehicles at each arm of the traffic junctions. The outputs of the detectors shall indicate the presence of vehicles and shall used to influence the operation of the traffic signal controller and shall generate counts, demands and extensions for right-of-way. Means shall be provided so that a detector may be connected to demand and / or extend a phase movement as specified.

The contractor shall clearly specify the placement of the detector (upstream, downstream, stop-line, exit etc.) for independent straight and right turn signals.

The detector shall be able to count vehicles in non-lane based mixed traffic flow conditions and differentiate between different vehicle types (two-wheeler, three-wheeler, car, HGV, etc.). The accuracy of counts shall be bigger than 90% over all light and weather conditions. The contractor shall clearly specify in their technical proposal how this will be accomplished.

The contractor shall give an estimate of the total number of vehicle presence detection zones and vehicle detectors required and the type of detection system recommended.

A detector that does not change its status at least once during a stage execution shall be notified to the Central Computer (in ATCS mode) at the termination of the associated stage.

8.1.3. 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 Traffic Management Centre. Central Computer running the ATCS application shall calculate and send optimum signal timings to all intersections in the corridor. 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 Traffic Management Centre and remote intersections for establishing the communication network.

8.1.4. ATCS Application Software

Objective of the ATCS 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 will provide simulation based real time traffic flow modelling capability with the capacity to calculate traffic flows, OD movements, and queues and turning movement along entire primary road transport network in the defined study area covering the ATCS junctions and beyond. The Application software or platform will be able to predict traffic flow in the network for the near term over various interval horizons (e.g T+5, T+10 … T+30 mins). The ATCS application will provide estimated traffic flow for each of the junction to calculate optimal cycle times, effective green time ratios, and change intervals for all system traffic signal controllers connected to it either as individual junctions or groups of junctions. These calculations will be based up on assessments carried out by the ATCS 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 ATCS application software shall be divided into two module with the following are the expected capabilities of the individual modules:

Module 1: Real Time Traffic Prediction Capability

- Shall provide a decision support tool for assessing strategies to minimize congestion, delays and emergency response time to events via simulation and planning tools liked with real time traffic data fusion and control of traffic signaling infrastructure on ground.

- Shall collect continuously information about current observed traffic conditions from a variety of data sources (like Bus GPS data, parking data, mobile phone data etc. Bidders can propose alternate data sources that could be integrated) and of different kind (traffic states, signal states, vehicle trajectories, incidents, road works etc.)

- Shall infer a coherent and comprehensive observed traffic state (speeds, vehicular densities, and presence of queues) on all network elements, from above mentioned observations, including vehicle trajectories, through a number of map matching, data validation, harmonization and fusion processes

- Shall have a ***Graphical User Interface*** (GUI) to be able to display traffic state along the observed and unobserved parts of the network through GIS maps (PMC is in process of implementing an enterprise GIS System. The bidder is expected to create a layer of edge equipment within that GIS platform and integrate with ATMS modules) of the transport network and must be able to display traffic flow, building of queues, delays, location of traffic signals and junctions, key Points of Interests (POI), Variable Message signs etc. In addition, the GUI must be:

    o Flexible for the operators to zoom and navigate with ability to interact with objects on the map.

    o Should be interoperable across multiple platforms and key graphical results and MIS must be made available across the Web

    o Graphically present time-space diagram for selected corridors on desktop

    o Graphically present signal plan execution and traffic flow at the intersection on desktop

- Shall have the ability to predict, forecast and estimate the traffic pattern across the signals over the near term future (e.g T+5, T+10, T+15, T+30 mins ... T + 1 hour).

- Shall extrapolate the measurements made on a limited number of junctions and arms along the rest of the unmonitored network, and obtain an estimation of the traffic state of the complete network and the evolution of this traffic state over the near term future (e.g T+5, T+10, T+15, T+30 mins ... T + 1 hour).

- Shall be able to 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

- Shall provide customisable estimates of Key Performance Indicators (KPI) for alternate traffic management strategies to quickly assess the results

- Shall provide calculated traffic flows estimation and forecast, queues and delays to Urban Control and Adaptive Traffic Control Systems, allowing for proactive Traffic Management and Control;

- To raise 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);

- To 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";

- Shall include a traffic data warehouse (for minimum 5 years) for all historic traffic information gathered from the hardware installed on the road network. Bidder to propose how data storage requirements could be minimised using consolidation techniques.
- 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.
- 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

- 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

Module 2: Adaptive Traffic Control System

- To operate the traffic lights with the adaptive traffic controls, based on the current and forecasted traffic demand from the above Real Time Traffic Prediction Tool including the current incidents, thus optimizing the green waves continuously throughout the network

- Enable a smart public transport priority respecting the delays for all road users at once with the adaptive signal controller. To have the capability to integrate with Bus GPS data to identify oncoming buses at the junction and be able to provide priority clearance of buses.

- Identify the critical junction (Master Junction) for each of the defined corridor or a region based on maximum traffic demand and saturation.

- The critical junction cycle time estimated shall be used as the group cycle time i.e. cycle time common to all intersection in that corridor or region.

- Stage optimization to the best level of service shall be carried out based on the traffic demand.

- 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.

- Offset correction shall be carried out to minimize number of stops and delays along the corridor for the priority route and for the adjoining road network at once. Offset deviation shall be calculated with a traffic flow model based on the distance, traffic demand and speed between successive intersections and be corrected within 5 Minutes maximum.

- 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.

- The system shall use optimization algorithms that minimize a function based on the delays, number of stops and queue lengths simultaneously, using a traffic flow model, thus providing a true optimum for all road users

- Develop appropriate stage timing plans for each approach of every intersection under the ATCS, based on real time demand and the predicted traffic flow values from the traffic flow model.

- Propose timing plans to every intersection under the ATCS at least every five minutes

- Calculate the current queue lengths for each approach that has detection cycle-by-cycle based on the succession of time gaps between cars

- Adjust the proposed timing plans second-by-second according to the current and past detector states and the current queue lengths for every intersection under detection

- Enable transit signal priority with minimal disruption of car traffic, dependent on predefined weights for public transport vehicles in comparison to individual traffic. In order to decrease the workload for operation and maintenance, each supply item (road network, lanes, signals and detectors) shall be supplied just once, so that the all macro- and microscopic traffic models and the microscopic traffic flow software used for calibration and verification of the ATCS share the same supply.

- 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. Such estimation will be updated at least every 5 minutes or less, and will not be based on a machine learning approach that would not provide enough flexibility in case of unexpected events;

- Should be able to route emergency vehicles to minimize the impact of events on the travel time of emergency vehicles;

- Shall be able to export the calculated traffic flow data continually to a multi-modal journey-planner that allows all internet users in the city to find the best route with each traffic mode based on the current travel times in the network.

- Identify Priority routes and synchronize traffic in the Priority routes

- Manage and maintain communication with traffic signal controllers under ATCS

- Maintain database for time plan execution and system performance

- Maintain error logs and system logs

- Generate Reports on request

- The ATCS shall generate standard and custom reports for planning and analysis

8.1.5.   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.

- Intersection based reports

- 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).

- 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.

- 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.

- 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.

- Mode switching report – The report shall give details of the mode switching taken place on a day.

- Event Report - The report shall show events generated by the controller with date and time of event.

- Power on & down: The report shall show time when the master is switched on, and last working time of the master controller.

- 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.

- Plan Change – The report shall show the time of change of plan either through keypad or remotely through a PC or Server.

- RTC Failure – The report shall show the time when RTC battery level goes below the threshold value.

- 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.

- 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.

- Lamp Status Report – The report shall show lamp failure report with date and time of failure, colour of the lamp and associated phase

- Loop Failure Report – The report shall show the date and time of detector failure with detector number and associated phase.

- Conflict – The report shall show the conflict between lamps (RED, AMBER, GREEN) in the same phase or conflict between lamps with other phase.

- 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

- 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

8.1.6.   Graphical User Interface

The application software shall have the following Graphical User Interface (GUI) for user friendliness, which will have the following functionalities in additions to those described in Section 8.1.4 above:

- User login – Operator authentication shall be verified at this screen with login name and password

- 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.

- 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.

- Saturation Snapshot – This display shall show the current saturation levels of all intersections in a corridor.

- Reports Printing / Viewing – This link shall allow selection, viewing and printing of different reports available under ATCS

- Time-Space Diagram – The time-space diagram shall display the current stages being executed at every intersection in a corridor with immediate previous history.

- Junctions shall be plotted proportional to their distance on Y-axis and time elapsed for the stage in seconds on X-axis.

- Junction names shall be identified with each plot.

- Facility shall be available to plot the time-space diagram from history.

- Currently running stage and completed stages shall be identified with different colours.

- Stages identified for synchronization shall be shown in a different colour.

- Speed lines shall be plotter for stages identified for synchronization to the nearest intersection in both directions.

- It should be possible to freeze and resume online plotting of Time-Space diagram.

- The system shall have other graphical interfaces for configuring the ATCS, as appropriate.

8.2. Functional Requirements of the Red Light Violation Detection Systems

Sl. No.	SYSTEM PARAMETER
1	**General**
a.	The following Traffic violations to be automatically detected by the system by using appropriate Non-Intrusive sensors technology: 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. c) Besides, a closer view indicating readable registration number plate patch of the violating vehicle for court evidence for each violation.
d.	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.
e.	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.
f.	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.
g.	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.
h.	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.
2	**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
3	**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 TCC 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 TCC 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.
4	**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.
5	**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 print the photograph of violations captured by the outstation system which would 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 along with all data as per clause 4.

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 Pune 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 75% or better during the day time and 40% or better during the night time with a standard number plate.
g.	The application software should be integrated with the eChallan 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 SI.
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 evidence of Infraction should be encrypted and protected so that any tampering can be detected.
n.	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.
o.	System shall use open standards and protocols to the extent possible and declare the proprietary software wherever used.
p.	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.
q.	The data provided for authentication of violations should be in an easy to use format as per the requirements of user.
r.	User should be provided with means of listing the invalid violations along with the reason(s) of invalidation without deleting the record(s).

s.	Basic image manipulation tools (zoom etc.) should be provided for the displayed image but the actual recorded image should never change.
t.	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).
u.	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 (Speed of violating vehicle, notified speed limit, Signal Jumping, Stop Line Violation, Speed Violation with Registration Number Plate Recognition facility.
v.	Number plate should be readable automatically by the software/interface. There should be user interface for simultaneous manual authentication / correction and saving as well.
w.	Interface for taking prints of the violations (including image and above details).

8.3.   Functional Requirements of the Variable Message Sign Boards

Sl. No.	Description
1.	**System Requirements**
a.	The system should be capable to display warnings, traffic advice, route guidance and emergency messages to motorists from the TMC in real time.
b.	The system should also be capable to display warnings, traffic advice, route guidance and emergency messages to motorist by using local PC/Laptops.
c.	The VMS should display text (multi lingual – Marathi, Hindi & English) and graphic messages using Light Emitting Diode (LED) arrays.
d.	The System should able to display failure status of any LED at TCC.
e.	The System should support Display characters in true type fonts and adjustable based on the Operating system requirement.
f.	The VMS workstation at the TCC should communicate with the VMS controller through the network. It should send out command data to the variable message sign controller and to confirm normal operation of the signboard. In return, the VMS workstation should receive status data from the VMS controller.
g.	VMS controllers should continuously monitor the operation of the VMS via the provided communication network.
h.	Operating status of the variable message sign should be checked periodically from the TCC.
i.	It shall be capable of setting an individual VMS or group of VMS's to display either one of the pre-set messages or symbols entered into the computer via the control computer keyboard or by another means.

j.	It shall be capable of being programmed to display an individual message to a VMS or a group of VMS's at a pre-set date and time.
k.	A sequence of a minimum of 10 messages/pictures/ pre-decided sign or group of signs shall be possible to assign for individual VMS or group of VMS's.
l.	It shall also store information about the time log of message displayed on each VMS. The information stored shall contain the identification number of the VMS, content of the message, date and time at which displayed message/picture starts and ends.
m.	The central control computer shall perform regular tests (pre-set basis) for each individual VMS. Data communication shall be provided with sufficient security check to avoid unauthorized access.
2.	**Variable Message Sign board application**
a.	Central Control Software allows controlling multiple VMS (upto 10) from one console.
b.	Capable of programming to display all types of Message/ advertisement having alphanumeric character in English, Hindi, Marathi and combination of text with pictograms signs.
c.	Capable of controlling and displaying messages on VMS boards as individual/ group.
d.	Capable of controlling and displaying multiple font types with flexible size and picture sizes suitable as per the size of the VMS.
e.	Capable of controlling brightness & contrast through software.
f.	Capable to continuously monitor the operation of the Variable Message sign board, implemented control commands and communicate information to the Traffic Monitoring Centre via communication network.
g.	Real time log facility – log file documenting the actual sequence of display to be available at central control system.
h.	Multilevel event log with time & date stamp.
i.	Access to system only after the authentication and acceptance of authentication based on hardware dongle with its log.
j.	Location of each VMS will be plotted on GIS Map with their functioning status which can be automatically updated.
k.	Report generation facility for individual/group/all VMSs with date and time which includes summary of messages, dynamic changes, fault/repair report and system accessed logs, link breakage logs, down time reports or any other customized report.
l.	Configurable scheduler on date/day of week basis for transmitting pre-programmed message to any VMS unit.
m.	Various users should 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.
n.	Apart from role based access, the system should also be able to define access based on location.

o.	Rights to different modules / Sub-Modules / Functionalities should be role based and proper log report should be maintained by the system for such access	
p.	Components of the architecture must provide redundancy and ensure that there are no single points of failure in the key project components. To take care of remote failure, the systems need to be configured to mask and recover with minimum outage.	
q.	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.	
r.	System shall use open standards and protocols to the extent possible	
s.	Facility to export reports to excel and PDF formats.	
3.	**Remote Monitoring**	
a.	All VMS shall be connected/configured to Traffic Monitoring Centre for remote monitoring through network for two way communication between VMS and control Room to check system failure, power failure & link breakage.	
b.	Remote Diagnostics to allow identifying reason of failure upto the level of failed individual LED.	

8.4.   Functional Requirement of the eChallan application:

The objective of the eChallan application is as follows:

1. Issuing challan for traffic violations on a 24x7 basis.

2. Maintaining the details pertaining to all the activities of the Traffic circles/violations/violators.

3. Providing requisite structured/unstructured information to the traffic management officials as and when required.

4. Generating various statutory reports for the administrative use and functioning of the Traffic unit in matters of prosecution of violators and monitoring the functioning of field officers.

5. Integrating and networking the system with state-of-the-art hardware and application software for the Traffic Police to access and using the information in their day-to-day work.

The following are the key functional requirements of the eChallan System:

1. E-challan software shall work in client -server mode, where the handheld devices units, workstation units will act as clients connected to the server through cellular network for data transfer.

2. E-challan system shall be able to retrieve vehicle owners details and vehicle data from RTO data base to minimise data entry

3. E-challan system shall be able to retrieve vehicle registration details and driving license details by reading appropriate smart card to minimize data entry

4. 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

5. 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

6. A unique Challan number should be generated through client software for each challan

7. 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

8. 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

9. Date, time and GPS coordinates of place of challan should be automatically populated in the relevant fields of client software

10. Compounding amount must populate in the field automatically from master table

11. The successful bidder should develop the GUI and functionality as per requirements of the Pune Traffic Police

12. The GUI should be Multi lingual i.e English, Hindi and Marathi

13. It should be possible to integrate payment gate way operator with the system for facilitation of payment

14. The Application Software should work in a web based environment.

15. The application software should be user friendly, easy to operate

16. The software must provide comprehensive data back-up and restoration capability.

17. The system will function in web-based system where the hand-held device shall work as a node.

18. The application software should maintain the logs of user activities to facilitate the audit trail.

19. The system should have sufficient security features such as firewall, access control system, biometrics, password protection, audit trail, anti-virus etc.

20. Database server 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.

21. The software should be able to generate various periodical reports, summaries, MIS reports, query reply etc... as per the requirements of Pune Traffic Police.

22. 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.

23. All database tables, records etc. required for various dropdown menus etc. shall also be created by the vendor.

24. The application software is to be provided by the vendor to handle various processes of the prosecution required by the office of senior police officers, Courts etc.

Hand Held Devices

1. 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.

2. On switching on the hand-held device the system must give access only after validation through user ID and password.

3. The communication between the server and hand-held device would be through GSM/GPRS/ 3G or better connectivity etc .....

4. Every challan created must have a unique self-populated number.

5. The HH 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.

6. The HH 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.

7. 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 Pune Traffic Police.

8. When a challan is issued, the name and ID of the officer should be printed on the Challan.

9. The HH device must be able to input and print multiple offences on the same Challan.

10. The HHD 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.

11. When downloading application software or pop-up tables or lists to the HH, or uploading challan records to the Server, synchronization of HH system must be automatic, in order to minimize human intervention.

12. Uploading data to the Database Server should be automatic in consistent manner.

13. 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.

14. Software should capture the list of documents seized during prosecution and such list must be reflected on the printed court challan.

15. The handheld application software shall allow the user to generate a summary report to facilitate evaluation of his daily work.

16. Once the Challan is complete and saved any further editing should not be possible unless so authorized by administrator.

17. Each hand-held device should be provided with original printed user manual and appropriate carry case for HH device with charger.

18. The application software should allow online payment

19. 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.

20. The software should update DL/RC smart card with the booked offence.

9. Annexure III- Technical Specifications

9.1. Adaptive Traffic Control- Traffic Sensor

Appropriate camera based traffic sensors may be chosen to provide the operational levels and accuracy as required for successful function of the ATMS system as per the SLAs defined

9.2. Adaptive Traffic Control- Traffic Controller

Appropriate camera based traffic sensors may be chosen to provide the operational levels and accuracy as required for successful function of the ATMS system as per the SLAs defined

9.3. Adaptive Traffic Control- Traffic Light Aspects

Key Features:

1. lowest power consumption for all colors
2. Meets or exceeds intensity, colour and uniformity specifications
3. Temperature compensated power supplies
4. Uniform appearance light diffusing
5. ITE products shall be Intertek/ETL/EN/Equivalent certified
6. All units operate on AC or DC as the per the suggested solution by bidder

LED aspects:

1. Red, Amber, Green-Full (300 mm diameter) : Hi Flux
2. Red, Amber, Green-arrow (300 mm diameter): Hi flux
3. Red, Green-Pedestrian (300 mm diameter):Hi Flux and Hi Brite
4. Animated Pedestrian-Red and Green Animated c/w countdown (200 mm) Hi Brite with diffusions

LED Retrofit Specifications:

1. Power supply : 230 Vac *10% and frequency 50*5Hz
2. Standards : EN 12368 complaint
3. Convex Tinted Lense : Available
4. Fuse and Transients : Available
5. Operating Temperature Range : 0⁰ Celsius to 55⁰ Celsius
6. Turn Off/Turn On Time : max 75 milli seconds
7. Total Harmonic Distortion : <20%
8. Electromagnetic interference : Meets FCC Title 47, Subpart B, Section 15 Regulation or equivalent EN/IRC standard
9. Blowing Rain/Dust Spec : MIL 810F complaint or equivalent EN/IRC standard
10. Minimum Luminous Intensity (measured at intensity point)(nm): Red 250, Amber 250, Green 250

11. Dominant Wavelength (nm)   : Red 630, Amber 590, Green 490
12. Lamp conflict compatibility system: Compatible with lamp failure and conflict detection

Configuration

Sample drawings below is for indicative purpose only, the bidders may propose their own design meeting the specifications.

Traffic Aspects: Assuming per arm- 1 set of aspects on main pole and one on the cantelever, with additional green for the right turn, assuming left turns as free.

Pedestrian - Assuming 2 set of Pedestrian Lamps per arm

An indicative detailed list of requirement for the number of aspects for each junction is given in **Annexure 10.2**. Please note that the requirement below is for bidders to prepare financial quote and may undergo changes after the bidder survey due to actual requirements, changes in junction dimensions, addition/ deletion of junction.

9.4.   Red Light Violation Detection Systems

#	Description	
1.	**General**	
	The system should be capable of generating a video in any of the standard industry formats 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 (t being the instant at which the infraction occurred). The system should have capability to detect both Retroreflective and Non Retroreflective number plates for the vehicles during the day as well as night time as per the accuracy levels specified.	
2.	**Automatic Number Plate Recognition (ANPR) Camera**	
a.	Sensor Type	Progressive scan CCD/CMOS, Day/Night Camera
b.	Resolution	2 Megapixels or better
c.	Video Compression:	Motion JPEG,H.264

d.	Normal Horizontal Field of View	atleast 3.5 Mtr. (One lane)
e.	Typical Range	30 Mtrs. or better
f.	Operating Temp.	0 to 55 Degree C
g.	Auto Iris Control	Yes
h.	Protection rating	NEMA 4X / IP-66 rated
3.	**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 minimum 24 hour 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 55°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).	
g.	UPS Backup (of minimum 30 minutes) to be provided only for RLVD System	
4.	**Violation Transmission and Security**	
a.	Encrypted data, images and video pertaining to Violations at the Onsite processing station should be transmitted to the TMC electronically through GPRS based wireless technology with 3G upgradable to 4G, in Jpeg format.	
b.	Advanced Encryption Standard (AES) shall be followed for data encryption on site and TMC, 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 TMC within one day.	
5.	**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, Hard disk shall be possible	

9.5. eChallan Handheld device

Core board	
Operating System	Latest Windows or Android OS
Processor	Min 800 MHz
Memory (Flash ROM)	Minimum 512 MB
RAM	256 MB Min
Extend Slot	Micro SD 32 GB
Motherboard	
Display	Minimum 3.5 inch TFT LCD (Trans reflective screen VGA/QVGA)
Touch Screen	Yes
Form Factor	Any
GPS	GPS and A GPS
Bluetooth	Yes
Wifi	WiFi (802.11 b/g/n)
Thermal Printer	Printing of minimum 3 inch in width
Barcode scanner	1D and 2 Scanner
External Interface	USB HOST/RS232(Customized)
Protection class	IP54
Drop resistance level	1.5m
Camera	
Camera	3 MP Min
Camera- Video	Support still image and video capture
Keypad	
Front	QWERTY 42 Keys
Interface	
Mini-USB Connector	USB2.0 connection
SIM card slot	Yes
TF card slot	Yes
power jack	Yes
Audio Jack	Yes
Battery	
Type	rechargeable Li-ion battery 3000mAh
Operating & storage temperature	5℃--50℃
Operating & storage humidity	10% - 80%
Payment PINPAD	The device should have lPCI , EMV certified PINPAD as per RBI guideline for accepting payment through Credit / Debit card

9.6. Variable Message Sign Boards

#	Parameter	Description

1.	**Dimensions**	
a.	3.0 mtr length X 1.5 mtr height X 0.2 mtr depth. (3000mm x 1500mm X 200mm)	
2.	**Colour LED**	Full Colour, class designation C2 as per IRC/EN 12966 standard
3.	**Luminance Class/Ratio**	L3 as per IRC/EN 12966 standards.
4.	**Luminance Control & auto Diming**	
a.	Should be automatically provide different luminance levels but shall also be controllable from the traffic centre using software.	
b.	Auto dimming capability to adjust to ambient light level (sensor based automatic control)	
c.	Photoelectric sensor shall be positioned at the sign front and sign rear to measure ambient light. Capable of being continually exposed to direct sunlight without impairment of performance.	
5.	**Contrast Ratio**	R3 as per IRC/EN 12966 standard
6.	**Beam Width**	B6+ as per IRC/EN12966 standards.
7.	**Pixel Pitch**	20mm or better
8.	**Picture Display**	
a.	Atleast 300mm as per IRC /EN 12966 standards	
b.	Full Matrix: Number of lines & characters adjustable, active area: 2.88mX1.2m atleast	
c.	Synchronized Dot to Dot display.	
d.	Capable of displaying real time message generated by Traffic Monitoring Centre (TCC).	
e.	Special frontal design to avoid reflection.	
f.	Display shall be UV resistant	
9.	**Viewing Angle**	B6+ as per IRC/EN12966 standard- Viewing angle shall ensure message readability for motorists in all lanes of the approach road
10.	**Viewing Distance**	Suitable for readability from 150 Mtrs. or more at the character size of 240mm, from moving vehicles.
11.	**Self-Test**	
a.	VMS shall have self-test diagnostic feature to test for correct operation.	
b.	Display driver boards shall test the status of all display cells in the sign even when diodes are not illuminated.	
c.	All periodic self-test results shall be relayed to the TMC in real time to update status of VMS	
12.	**Alarms**	
a.	Door Open sensor to Inform Control room during unauthorized access	

	b.	LED Pixel failure detection alarm
13.	**Flicker**	Refresh Frequency should not be less 90 Hz. No visible flicker to naked eye.
14.	**Multiple Data Communication interface/Port**	RJ45 Ethernet, RS232, RS 485, FC port and any other suitable
15.	**Communication (connectivity)**	Wired/GPRS based wireless technology with 3G upgradable to 4G capability.
16.	**Ambient Operating Temperature**	The system should be capable of working in ambient temperature range of -5°C to 55°C.
17.	**Humidity (RH)**	Operating ambient humidity: 10% - 95% Rh or better.
18.	**Protection against Pollution/dust/water**	Complete VMS should be of IP 65 protection level from front and IP54 from side and rear. As per EN60529 or equivalent Standard.
19.	**Power**	
	a.	170-250V AC (more than 90% power factor) or DC as per equipment requirement.
	b.	Protection for overvoltage/ fluctuation/drop of the nominal voltage (50%) shall be incorporated.
	c.	The enclosure shall contain at least two 15 Amp VAC (industrial grade) outlet socket for maintenance purpose.
20.	**Power Back-up & its enclosure**	• UPS for 15 Mins power back-up with auto switching facility. The enclosure of UPS and battery should be pole mountable with IP 65 protected housing and lockable. • Batteries with solar charging options can also be recommended as back up
21.	**Material for VMS frame**	atleast 2mm aluminium or non-corrosive, water resistant or better
22.	**Mounting, Installation and finishes**	
	a.	Mounting structure shall use minimum 6 Mtrs. high hexagonal/octagonal MS Pole or suitable structure with 5.5 mtr. Minimum vertical clearance under the VMS sign from the Road surface.
	b.	The mounting shall be capable of withstanding road side vibrations at site of installation.
	c.	It shall be provided with suitable walkway for maintenance access.
	d.	The sides interior and rear of enclosures shall be provided in maintenance free natural aluminium finish. All enclosure shall be flat and wipe clean.
	e.	Rugged locking mechanism should be provided for the onsite enclosures and cabinets.

f.	For Structural safety, the successful bidder has to provide structural safety certificate from qualified structural engineers approved/ certified by Govt. Agency.	
23.	**Wind Load**	WL9 as per EN12966 to withstand high wind speeds and its own load.
24.	**Cabling, connections and Labelling.**	
a.	All cable conductors shall be of ISI marked for quality and safety. It shall be of copper insulated, securely fastened, grouped, wherever possible, using tie warps approximately every 10-20 Cms or cable trays.	
b.	All connections shall be vibration-proof quick release connections except for power cables terminating in terminal blocks, which shall be screwed down.	
c.	All terminal block shall be made from self-extinguishing materials. Terminations shall be logically grouped by function and terminals carrying power shall be segregated from control signal terminals.	
d.	All cables shall be clearly labelled with indelible indication that can clearly be identified by maintenance personnel using "As built : drawings".	
e.	Lightening arrester shall be installed for safety on each VMS.	
f.	The successful bidder has to provide safety certificate from qualified Electrical engineers approved/certified by Govt. Agency.	
26.	**Local Storage in VMS**	Embedded VMS controller should be capable to store atleast 100 messages and symbols/pictograms to allow display to run in isolated mode on a predefined structures/timings, in case of connectivity failure.

9.7. Field Junction Box

#	Parameter	Minimum Specifications
1.	Size	Suitable size as per site requirements to house the field equipment
2.	Cabinet Material	Powder coated CRCA sheet/ Stainless steel
3.	Material Thickness	Min 1.2mm
5.	Number of Locks	Two
6.	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
7	Mounting	On Camera Pole / Ground mounted on concrete base
8.	Form Factor	Rack Mount/DIN Rail
9.	Other Features	Rain Canopy, Cable entry with glands and Fans/any other accessories as required for operation of equipment's within junction box.

9.8. Poles for camera (f existing structures / poles can't be used)

#	Parameter	Minimum Specifications
1.	Pole type	Hot Dip Galvanized after Fabrication with Silver coating of 86 micron as per IS:2629; Fabrication in accordance with IS-2713 (1980)
2.	Height	5-10 Meters, as-per-requirements for different types of cameras & Site conditions
3.	Pole Diameter	Min. 10 cm diameter pole (bidder to choose larger diameter for higher height)
4.	Cantilevers	Based on the location requirement suitable size cantilevers to be considered with the pole
5.	Bottom base plate	Minimum base plate of size 30x30x1.5 cm
6.	Mounting facilities	To mount RLVD Cameras, CCTV cameras, Traffic Signals, Pedestrian Signals, Switch, etc.
7.	Pipes, Tubes	All wiring must be hidden, through tubes/pipes. No wires shall be visible from outside.
8.	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.
9.	Protection	Lightning arrester at select sites as per the requirements

9.9. Edge Level Switch (at Traffic Junctions)

#	Parameter	Minimum Specifications
1.	Type	Managed Outdoor Industrial grade switch
2.	Total Ports	• Minimum 4 10/100-TX PoE/PoE+, 2x SFP Ports (can have 4xSFP Ports in certain locations) • May require higher port density at some locations, depending upon site conditions • May require fiber ports at some locations, depending upon site conditions/distances.
3.	PoE Standard	IEEE 802.3af/ IEEE 802.3at or better
4.	Protocols	• IPV4,IPV6 • Support 802.1Q VLAN • DHCP support

		• IGMP
		• SNMP Management
		• Should support Loop protection and Loop detection
		• Should support Ring protection
		• End point Authentication
		• Should support NTP
5.	Access Control	• Support port security • Support 802.1x (Port based network access control). • Support for MAC filtering
6.	PoE Power per port	Sufficient to operate the CCTV cameras/edge devices connected
7.	Enclosure Rating	IP 30 or equivalent Industrial Grade Rating(to be housed in Junction box)
8.	Operating Temperature	0 -50 C or better Industrial Grade Rating
9.	Multicast support	IGMP Snooping V1, V2, V3 MLD Snooping V1, V2
10.	Management	Switch needs to have RS-232/USB/RJ45 console port for management via a console terminal or PC Web GUI NTP Syslog for log capturing SNMP V1,V2,V3
11.	Compliance	UL/EN/IEC or equivalent

9.10. Switch

#	Parameter	Minimum Specifications
1.	Ports	• 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.
2.	Switch type	Layer 3
3.	MAC	Support 32K MAC address.
4.	Backplane	Capable of providing wire-speed switching
5.	Throughput	500 Mpps or better
6.	Port Features	Must support Port Mirroring, Port Trunking and 802.3ad LACP Link Aggregation port trunks

#	Parameter	Minimum Specifications
7.	Flow Control	Support IEEE 802.3x flow control for full-duplex mode ports.
8.	Protocols	• 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
9.	Access Control	• Support port security • Support 802.1x (Port based network access control). • Support for MAC filtering. • Should support TACACS+ and RADIUS authentication
10.	VLAN	• 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
11.	Protocol and Traffic	• 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
12.	Management	• 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
13.	Resiliency	• Dual load sharing AC and DC power supplies • Redundant variable-speed fans

9.11. Router (if required as per the technical design)

#	Item	Minimum Specifications

1.	Multi-Services	Should deliver multiple IP services over a flexible combination of interfaces
2.	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.
3.	Interface modules	Must support up to 10G interfaces as per the design. Must have capability to connect with variety of interfaces.
4.	Protocol Support	• Must have support for TCP/IP, PPP, X.25, Frame relay and HDLC • Must support VPN • Must have support for integration of data and voice services • Routing protocols of RIP, OSPF, and BGP. • Support IPV4, IPV6 • Support load balancing
5.	Manageability	Must be SNMP manageable
6.	Traffic control	Traffic Control and Filtering features for flexible user control policies
7.	Bandwidth	Bandwidth on demand for cost effective connection performance enhancement
8.	Remote Access	Remote access features
	Redundancy	• 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
9.	Security features	• MD5 encryption for routing protocol • NAT • RADIUS / AAA Authentication • Management Access policy • IPSec / Encryption • L2TP
10.	QOS Features	• RSVP • Priority Queuing • Policy based routing • Traffic shaping • Time-based QoS Policy • Bandwidth Reservation / Committed Information Rate

9.12. Servers

#	Parameter	Minimum Specifications
1.	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
2.	RAM	Minimum 64 GB Memory per physical server
3.	Internal Storage	2 x 300 GB SAS (10k rpm) hot swap disk with extensible bays
4.	Network interface	2 X 20GbE LAN ports for providing Ethernet connectivity
		Optional: 1 X Dual-port 16Gbps FC HBA for providing FC connectivity
		The required connectivity can be provided using converged FCOE ports on Blade servers
5.	Power supply	Dual Redundant Power Supply
6.	RAID support	As per requirement/solution
7.	Operating System	Licensed version of 64 bit latest version of Linux/ Unix/Microsoft® Windows based Operating system)
8.	Form Factor	Rack mountable/ Blade
9.	Virtualization	Shall support Industry standard virtualization hypervisor like Hyper-V, VMWARE and Citrix.

9.13. Blade Chassis Specifications

The blade chassis shall have the following minimum technical specifications:

1) Minimum 6U size, rack-mountable, capable of accommodating minimum 8 or higher hot pluggable blades

2) Dual network connectivity of 10 G speed for each blade server for redundancy shall be provided

3) Backplane shall be completely passive device. If it is active, dual backplane shall be provided for redundancy.

4) Have the capability for installing industry standard flavors of Microsoft Windows, and Enterprise RedHat Linux Oss as well as virtualization solution such as VMware.

5) DVD ROM shall be available in chassis, can be internal or external, which can be shared by all the blades allowing remote installation of software

6) Minimum 1 USB port

7) Two hot-plug/hot-swap, redundant 10 Gbps Ethernet or FCoE module with minimum 16 ports (cumulative), having Layer 2/3 functionality

8) Two hot-plugs / hot-swap redundant 16 Gbps Fiber Channel or FCoE module for connectivity to the external Fiber channel Switch and ultimately to the storage device

9) Hot plug/hot-swap redundant power supplies to be provided, along with power cables

10) Power supplies shall have N+N. All power supplies modules shall be populated in the chassis.

11) Required number of PDUs and power cables, to connect all blades, Chassis to Data Center power outlet.

12) Hot pluggable/hot-swappable redundant cooling unit

13) Provision of systems management and deployment tools to aid in blade server configuration and OS deployment

14) Blade enclosure shall have provision to connect to display console/central console for local management such as troubleshooting, configuration, system status/health display.

15) Single console for all blades in the enclosure, built-in KVM switch or Virtual KVM features over IP

16) Dedicated management network port shall have separate path for remote management.

9.14. Storage

#	Parameter	Minimum Specifications
1.	Solution/ Type	• IP Based/iSCSI/FC/NFS/CIFS
2.	Storage	• Storage Capacity should be minimum 10 TB (usable, after RAID configuration) • Disks should be preferably minimum of 3 TB capacity • To store all types of data (Data, Voice, Images, Video, etc) • Storage system should be capable of upward scalability
3.	Hardware Platform	• Rack mounted form-factor • Modular design to support controllers and disk drives expansion
4.	Controllers	• At least 2 Controllers in active/active mode • The controllers / Storage nodes should be upgradable seamlessly, without any disruptions / downtime to production workflow for performance, capacity enhancement and software / firmware upgrades.
5.	RAID support	• Should support various RAID levels (RAID 6 or equivalent)
6.	Cache	• Minimum 64 GB of useable cache across all controllers. If cache is provided in additional hardware for unified storage solution, then cache must be over and above 64 GB.
7.	Redundancy and High Availability	• 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.
8.	Management software	• All the necessary software (GUI Based) to configure and manage the storage space, RAID configuration, logical drives allocation, snapshots etc. are to be provided for the entire system proposed. • Licenses for the storage management software should include disc capacity/count of the complete solution and any additional disks to

		be 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
9.	Data Protection	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

9.15. Video Wall / Video Screen

#	Parameter	Minimum Specifications
1.	Technology	Solid state LED illumination technology or Direct LED IPS based Technology or equivalent
2.	Display Unit	The Visual Display Unit / Rear Projection Module
3.	Screen Size	70" cubes in a 5 X 2 display
4.	Resolution	Full high definition (1920X1080)
5.	Brightness	Uniformity of 85%
6.	Contrast Ratio	Min. 1400 : 1
7.	Wall Uptime	Min. 60,000 hours of rated life (Expected to be operational 24X7)
8.	Viewing Angle	180 degree viewing angle
9.	Screen to Screen gap	The inter screen gap should be <= 1 mm
10.	Other Features	- RS232 control (with loop-through) - On Screen Display (OSD) - IR remote control - flicker free image on the Large Screen Graphics Wall
11.	Input	IP Based

9.16. Monitoring Workstations

#	Parameter	Minimum Specifications
1.	Processor	Latest generation 64bit X86 Quad core processor(3Ghz) or better
2.	Chipset	Latest series 64bit Chipset
3.	Motherboard	OEM Motherboard

4.	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
5.	Graphics card	Minimum Graphics card with 2 GB video memory (non- shared)
6.	HDD	2 TB SATA-3 Hard drive @7200 rpm with Flash Cache of 64GB SSD. Provision for installing 4 more drives.
7.	Media Drive	NO CD / DVD Drive
8.	Network interface	10/100/1000 Mbps autosensing on board integrated RJ-45 Ethernet port.
9.	Audio	Line/Mic IN, Line-out/Spr Out (3.5 mm)
10.	Ports	Minimum 6 USB ports (out of that 2 in front)
11.	Keyboard	104 keys minimum OEM keyboard
12.	Mouse	2 button optical scroll mouse (USB)
13.	PTZ joystick controller *(with 2 of the workstations in SCOC)*	• 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
14.	Monitor	22" TFT LED monitor, Minimum 1920 x1080 resolution, 5 ms or better response time, TCO 05 (or higher) certified
15.	Certification	Energy star 5.0/BEE star certified
16.	Operating System	64 bit pre-loaded OS with recovery disc
17.	Security	BIOS controlled electro-mechanical internal chassis lock for the system.
18.	Antivirus feature	Advanced antivirus, antispyware, 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)
19.	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.

9.17. Network Laser Color Printer

#	Parameter	Minimum Specifications
1	Print Speed	Black : 15 ppm or above on A3, 24 ppm or above on A4

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

9.18. Rack Specifications

#	Parameter	Minimum Specifications
1.	Type	• 19" 42U racks mounted on the floor • Floor Standing Server Rack - 42U with Heavy Duty Extruded Aluminium Frame for rigidity. Top cover with FHU provision. Top & Bottom cover with cable entry gland plates. Heavy Duty Top and Bottom frame of MS. Two pairs of 19" mounting angles with 'U' marking. Depth support channels - 3 pairs with an overall weight carrying Capacity of 500Kgs. • 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
2.	Wire managers	Two vertical and four horizontal
3.	Power Distribution Units	• 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

4.	Doors	• 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.
5.	Fans and Fan Tray	• 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
6.	Metal	Aluminium extruded profile
7.	Side Panel	Detachable side panels (set of 2 per Rack)

9.19. Online UPS

#	Parameter	Minimum Specifications
1.	Capacity	Adequate capacity to cover all above IT Components at respective location
2.	Output Wave Form	Pure Sine wave
3.	Input Power Factor at Full Load	>0.90
4.	Input	Three Phase 3 Wire for over 5 KVA
5.	Input Voltage Range	305-475VAC at Full Load
6.	Input Frequency	50Hz +/- 3 Hz
7.	Output Voltage	400V AC, Three Phase for over 5 KVA UPS
8.	Output Frequency	50Hz+/- 0.5% (Free running); +/- 3% (Sync. Mode)
9.	Inverter efficiency	>90%
10.	Over All AC-AC Efficiency	>85%
11.	UPS shutdown	UPS should shutdown with an alarm and indication on following conditions 1)Output over voltage 2)Output under voltage 3)Battery low 4)Inverter overload 5)Over temperature 6)Output short

#	Parameter	Minimum Specifications
12.	Battery Backup	30 minutes in full load
13.	Battery	VRLA (Valve Regulated Lead Acid) SMF (Sealed Maintenance Free) Battery
14.	Indicators & Metering	Indicators for AC Mains, Load on Battery, Fault, Load Level, Battery Low Warning, Inverter On, UPS on Bypass, Overload, etc. Metering for Input Voltage, Output Voltage and frequency, battery voltage, output current etc.
15.	Audio Alarm	Battery low, Mains Failure, Over temperature, Inverter overload, Fault etc.
16.	Cabinet	Rack / Tower type
17.	Operating Temp	0 to 50 degrees centigrade
18.	Management Protocol	SNMP Support through TCP/IP

9.20. DG Set

#	Item	Minimum Specifications
1	General Specifications	• Auto Starting DG Set mounted on a common base frame with AVM (Anti-Vibration) pads, residential silencer with exhaust piping, complete conforming to ISO 8528 specifications and CPCB certified for emissions. • KVA rating as per the requirement
2	Engine	Radiator cooled, multi cylinder, 1500 RPM diesel engine, with electronic/manual governor and electrical starting arrangement complete with battery, conforming to BS 5514/ ISO 3046/ IS 10002
3	Fuel	High Speed Diesel (HSD)
5	Alternator	Self-exciting, self-regulating type alternator rated at 0.8 PF or better, 415 Volts, 3 Phase, 4 wires, 50 cycles/sec, 1500 RPM, conforming to IS 4722/ BS 5000, Windings of 100% Copper, class H insulation, Protection as per IP 23.
6	AMF (Auto Main Failure) Panel	AMF Panel fitted inside the enclosure, with the following: It should have the following meters/indicators • Incoming and outgoing voltage • Current in all phases • Frequency • KVA and power factor

		• Time indication for hours/minutes of operation • Fuel Level in fuel tank, low fuel indication • Emergency Stop button • Auto/Manual/Test selector switch • MCCB/Circuit breaker for short-circuit and overload protection • Control Fuses • Earth Terminal • Any other switch, instrument, relay etc. essential for Automatic functioning of DG set with AMF panel
7	Acoustic Enclosure	• The DG set shall be provided with acoustic enclosure / canopy to reduce the sound level and to house the entire DG set (Engine & Alternator set) assembly outside (open-air). • The enclosure must be weather resistant powder coated, with insulation designed to meet latest MOEF/CPCB norms for DG sets, capable to withstand Hyderabad climate. The enclosure must have ventilation system, doors for easy access for maintenance, secure locking arrangement, complete and
8	Fuel Tank Capacity	It should be sufficient and suitable for containing fuel for minimum 12 hours continuous operation, Complete with level indicator, fuel inlet and outlet, air vent, drain plug, inlet arrangement for direct filling and set of fuel hoses for inlet and return.

9.21. Structured Cabling Components

#	Parameter	Minimum Specifications
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

9.22. Electrical cabling component

#	Parameter	Minimum Specifications
1.	Standards	All electrical components shall be design manufactured and tested in accordance with relevant Indian standards IEC's

9.23. Enterprise Management System (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 –

- Network Monitoring System
- Server Monitoring System
- Helpdesk System

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

- **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.

  o 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.

  o Proposed solution should provide customizable reporting interface to create custom reports for collected data.

  o The system must use advanced root-cause analysis techniques and policy-based condition correlation technology for comprehensive analysis of infrastructure faults.

  o The system should be able to clearly identify configuration changes and administrators should receive an alert in such cases.

- **Server Performance Monitoring System**

  o The proposed tool should integrate with network performance management system and support operating system monitoring for various platforms supplied as part of this Project.

  o The proposed tool must provide information about availability and performance for target server nodes.

  o The proposed tool should be able to monitor various operating system parameters such as processors, memory, files, processes, file systems, etc. where applicable.

- **Centralized Helpdesk System**

  o 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.

  o System should also automatically create tickets based on alarm type

    o   The proposed helpdesk solution must provide flexibility of logging, viewing, updating and closing incident via web interface for issues related to the project.

9.24. Centralised 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 defence

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.

10. Annexure IV- List of Locations

10.1. List of Existing Traffic Signals

S No.	Junction Name	Jurisdiction	Signal Type
1.	Gotiram Bhaiyya Square	PMC	Fixed Time Traffic Signal
2.	Fad Gate Chowki	PMC	Fixed Time Traffic Signal
3.	Hirabaug Square	PMC	Fixed Time Traffic Signal
4.	Puram Square	PMC	Fixed Time Traffic Signal
5.	Vinoba Bhave Square	PMC	Fixed Time Traffic Signal
6.	SP College Square	PMC	Fixed Time Traffic Signal
7.	Rashtrabhushan Square	PMC	Fixed Time Traffic Signal
8.	Govind Halwai Square	PMC	Fixed Time Traffic Signal
9.	Sant Kabir Square	PMC	Fixed Time Traffic Signal
10.	Ramoshi gate Square	PMC	Fixed Time Traffic Signal
11.	Bhagwan bahubali Square	PMC	Fixed Time Traffic Signal
12.	Narapatgeer Square	PMC	Fixed Time Traffic Signal
13.	Dr. Surendranath Banerjee Square	PMC	Fixed Time Traffic Signal
14.	Hedgewar (Gadgil) Square	PMC	Fixed Time Traffic Signal
15.	Jijamata Square	PMC	Fixed Time Traffic Signal
16.	Budhwar Square	PMC	Fixed Time Traffic Signal
17.	Rameshwar Square	PMC	Fixed Time Traffic Signal
18.	H.M.J Khan Square	PMC	Fixed Time Traffic Signal
19.	Sonya Maruti Square	PMC	Fixed Time Traffic Signal
20.	Belbaug Square	PMC	Fixed Time Traffic Signal
21.	Phadke Haud Square	PMC	Fixed Time Traffic Signal
22.	Kumbhar Vesh Square	PMC	Fixed Time Traffic Signal
23.	Seva Sadan Square	PMC	Fixed Time Traffic Signal
24.	Kunte Square	PMC	Fixed Time Traffic Signal
25.	Holkar Square	PMC	Fixed Time Traffic Signal
26.	Umbrya Ganapati Square	PMC	Fixed Time Traffic Signal
27.	Tilak Square	PMC	Fixed Time Traffic Signal
28.	Alka Square	PMC	Fixed Time Traffic Signal
29.	Gadgil Bridge (towards Narayan Peth)	PMC	Fixed Time Traffic Signal
30.	Shanipar Square	PMC	Fixed Time Traffic Signal
31.	Appa Balwant Square	PMC	Fixed Time Traffic Signal
32.	Tilak Smarak/ Badshahi Square	PMC	Fixed Time Traffic Signal
33.	Sahitya Parishad Square	PMC	Fixed Time Traffic Signal
34.	Visava Maruti Square	PMC	Fixed Time Traffic Signal
35.	Shamrav ganjve Square	PMC	Fixed Time Traffic Signal
36.	Senadatta Police Chowki	PMC	Fixed Time Traffic Signal
37.	Takle Haveli Square	PMC	Fixed Time Traffic Signal
38.	New English/ Tilak Square	PMC	Fixed Time Traffic Signal

39.	Khadoji Baba Square	PMC	Fixed Time Traffic Signal
40.	Shelar Mama Square	PMC	Fixed Time Traffic Signal
41.	Yeshwantrao Chavan Bridge Square	PMC	Fixed Time Traffic Signal
42.	Rasashala Square	PMC	Fixed Time Traffic Signal
43.	Swatantyra Square	PMC	Fixed Time Traffic Signal
44.	Prabhat Road T-junction	PMC	Fixed Time Traffic Signal
45.	Bhandarkar T-junction	PMC	Fixed Time Traffic Signal
46.	Natraj Square	PMC	Fixed Time Traffic Signal
47.	Jhashi Rani Square	PMC	Fixed Time Traffic Signal
48.	Modern High school Square	PMC	Fixed Time Traffic Signal
49.	S.G. Barve Square	PMC	Fixed Time Traffic Signal
50.	Shivaji Statue Square	PMC	Fixed Time Traffic Signal
51.	Premier Garage Square	PMC	Fixed Time Traffic Signal
52.	Khude Square	PMC	Fixed Time Traffic Signal
53.	Sawarkar Bhavan Square	PMC	Fixed Time Traffic Signal
54.	Goodluck SSquare	PMC	Fixed Time Traffic Signal
55.	Tukaram Paduka Square	PMC	Fixed Time Traffic Signal
56.	Fergusson College Square	PMC	Fixed Time Traffic Signal
57.	Dyaneshwar Paduka Square	PMC	Fixed Time Traffic Signal
58.	Sancheti Square	PMC	Fixed Time Traffic Signal
59.	Simla Office Square	PMC	Fixed Time Traffic Signal
60.	Vir Chafekar Square	PMC	Fixed Time Traffic Signal
61.	Varje juncction	PMC	Fixed Time Traffic Signal
62.	Hingne Educational Trust	PMC	Fixed Time Traffic Signal
63.	Nal Stop Square	PMC	Fixed Time Traffic Signal
64.	Sahajivan Square	PMC	Fixed Time Traffic Signal
65.	Karve Statue	PMC	Fixed Time Traffic Signal
66.	Hutatma Rajguru Square	PMC	Fixed Time Traffic Signal
67.	Mayur Colony Square	PMC	Fixed Time Traffic Signal
68.	Konkan Express Square	PMC	Fixed Time Traffic Signal
69.	Dahanukar colony Square	PMC	Fixed Time Traffic Signal
70.	Paud Phata(below overbridge)	PMC	Fixed Time Traffic Signal
71.	Aathwale Square	PMC	Fixed Time Traffic Signal
72.	Kothrud PMT Depot	PMC	Fixed Time Traffic Signal
73.	Anandnagar Junction	PMC	Fixed Time Traffic Signal
74.	ARAI Kelewadi Junction	PMC	Fixed Time Traffic Signal
75.	Ogle Square	PMC	Fixed Time Traffic Signal
76.	Mahdev Mandir Square	PMC	Fixed Time Traffic Signal
77.	CDSS Square	PMC	Fixed Time Traffic Signal
78.	Karnatak highschoo Square	PMC	Fixed Time Traffic Signal
79.	Paramhans Naagr Square	PMC	Fixed Time Traffic Signal
80.	Gujrat Colony Square	PMC	Fixed Time Traffic Signal
81.	Pushpamangal Square	PMC	Fixed Time Traffic Signal

82.	Rawat Brothers	PMC	Fixed Time Traffic Signal
83.	Sharda Arcade	PMC	Fixed Time Traffic Signal
84.	Chavan Nagar Square	PMC	Fixed Time Traffic Signal
85.	Chandralok Hospital Square	PMC	Fixed Time Traffic Signal
86.	Mahesh Society Square	PMC	Fixed Time Traffic Signal
87.	Annabhau Sathe Square	PMC	Fixed Time Traffic Signal
88.	Balaji Nagar Square	PMC	Fixed Time Traffic Signal
89.	Dhankawdi Phata Square	PMC	Fixed Time Traffic Signal
90.	Padmawati Square	PMC	Fixed Time Traffic Signal
91.	Ahilyadevi Square	PMC	Fixed Time Traffic Signal
92.	Katraj Milk Diray	PMC	Fixed Time Traffic Signal
93.	Katraj Jakat Naka Bypass	PMC	Fixed Time Traffic Signal
94.	Dattanagar Square	PMC	Fixed Time Traffic Signal
95.	In front of Katraj Bypass (Satara Road)	PMC	Fixed Time Traffic Signal
96.	Shinde Highschool	PMC	Fixed Time Traffic Signal
97.	Muktangan highschool	PMC	Fixed Time Traffic Signal
98.	Bal Shivaji Square	PMC	Fixed Time Traffic Signal
99.	N.C.Fadke Square	PMC	Fixed Time Traffic Signal
100.	Dandekar bridge Square	PMC	Fixed Time Traffic Signal
101.	Ganesh Square	PMC	Fixed Time Traffic Signal
102.	Rajaram Bridge Square	PMC	Fixed Time Traffic Signal
103.	Sarasbaug (Sawarkar Square)	PMC	Fixed Time Traffic Signal
104.	Shivdarshan Square	PMC	Fixed Time Traffic Signal
105.	mitramandal Square	PMC	Fixed Time Traffic Signal
106.	Navshya Maruti Square	PMC	Fixed Time Traffic Signal
107.	Deepak nitrate/ Big Bazar	PMC	Fixed Time Traffic Signal
108.	Gajanan Maharaj	PMC	Fixed Time Traffic Signal
109.	Vishranti Nagar	PMC	Fixed Time Traffic Signal
110.	Hingne	PMC	Fixed Time Traffic Signal
111.	Santosh Hall	PMC	Fixed Time Traffic Signal
112.	Brahma Hotel	PMC	Fixed Time Traffic Signal
113.	Vadgaon Bridge	PMC	Fixed Time Traffic Signal
114.	Jedhe Square	PMC	Fixed Time Traffic Signal
115.	Holga Square	PMC	Fixed Time Traffic Signal
116.	Panchami Square	PMC	Fixed Time Traffic Signal
117.	Market Yard Square	PMC	Fixed Time Traffic Signal
118.	Gangadham junction	PMC	Fixed Time Traffic Signal
119.	Seven Loves Square	PMC	Fixed Time Traffic Signal
120.	Dayra Plot Square	PMC	Fixed Time Traffic Signal
121.	Giridhar Bhavan Sqaurre	PMC	Fixed Time Traffic Signal
122.	Vega Center	PMC	Fixed Time Traffic Signal
123.	Dhobi Ghat	PMC	Fixed Time Traffic Signal
124.	Vakhar Mahamandal	PMC	Fixed Time Traffic Signal

125.	Lulla Nagar Square	PMC	Fixed Time Traffic Signal
126.	Khadi Machine Square	PMC	Fixed Time Traffic Signal
127.	Jambhulkar Square	PMC	Fixed Time Traffic Signal
128.	Fatimanagar Square	PMC	Fixed Time Traffic Signal
129.	Sopanbaug Square	PMC	Fixed Time Traffic Signal
130.	Ramtekdi Square	PMC	Fixed Time Traffic Signal
131.	Solapur Bazar	PMC	Fixed Time Traffic Signal
132.	Vaiduvadi Square	PMC	Fixed Time Traffic Signal
133.	Hadapsar Bajar Square	PMC	Fixed Time Traffic Signal
134.	Magarpatta junction	PMC	Fixed Time Traffic Signal
135.	Magarpatta Main Gate	PMC	Fixed Time Traffic Signal
136.	Amanora Park	PMC	Fixed Time Traffic Signal
137.	Keshav Naagr mudhwa junction	PMC	Fixed Time Traffic Signal
138.	Bund Garden	PMC	Fixed Time Traffic Signal
139.	North main Road	PMC	Fixed Time Traffic Signal
140.	Blue Diamond Square	PMC	Fixed Time Traffic Signal
141.	Boat club Square/ Hemant Karkare Square	PMC	Fixed Time Traffic Signal
142.	Moboj Square	PMC	Fixed Time Traffic Signal
143.	mangaldas Square	PMC	Fixed Time Traffic Signal
144.	Jahangir Square	PMC	Fixed Time Traffic Signal
145.	ABC Farms	PMC	Fixed Time Traffic Signal
146.	Tadigutta Square	PMC	Fixed Time Traffic Signal
147.	RTO Square	PMC	Fixed Time Traffic Signal
148.	Alankar Square	PMC	Fixed Time Traffic Signal
149.	Pune Station Square	PMC	Fixed Time Traffic Signal
150.	blue nile Square	PMC	Fixed Time Traffic Signal
151.	Bolhai Sqaurre	PMC	Fixed Time Traffic Signal
152.	IB Square	PMC	Fixed Time Traffic Signal
153.	Council Hall Square	PMC	Fixed Time Traffic Signal
154.	Maldhakka Square	PMC	Fixed Time Traffic Signal
155.	Shahir Amarsheikh Square	PMC	Fixed Time Traffic Signal
156.	Nehru memorial hall Square	PMC	Fixed Time Traffic Signal
157.	Parnakuti Square	PMC	Fixed Time Traffic Signal
158.	Shastrinagar Square	PMC	Fixed Time Traffic Signal
159.	Kalyani nagar Junction	PMC	Fixed Time Traffic Signal
160.	Gunjan Square	PMC	Fixed Time Traffic Signal
161.	Golf Club SSquare	PMC	Fixed Time Traffic Signal
162.	Gold Adlabs	PMC	Fixed Time Traffic Signal
163.	Commerce Zone Company	PMC	Fixed Time Traffic Signal
164.	Yerwada Jail Junction	PMC	Fixed Time Traffic Signal
165.	Ambedkar Society	PMC	Fixed Time Traffic Signal
166.	Tarkeshwar Square	PMC	Fixed Time Traffic Signal
167.	Sadalbaba Square	PMC	Fixed Time Traffic Signal

168.	Garrison Enginneering	PMC	Fixed Time Traffic Signal
169.	Viman Nagar Junction	PMC	Fixed Time Traffic Signal
170.	Vadgaon Sheri	PMC	Fixed Time Traffic Signal
171.	Tata Gaurdroom Square	PMC	Fixed Time Traffic Signal
172.	Somnath Nagar	PMC	Fixed Time Traffic Signal
173.	Kharadi Bypass	PMC	Fixed Time Traffic Signal
174.	Chadrama Square	PMC	Fixed Time Traffic Signal
175.	Dighi Magazine	PMC	Fixed Time Traffic Signal
176.	Parihar Square	PMC	Fixed Time Traffic Signal
177.	Range Hills Square	PMC	Fixed Time Traffic Signal
178.	Rishi Malhotra Square	PMC	Fixed Time Traffic Signal
179.	SB Raod t junction	PMC	Fixed Time Traffic Signal
180.	Pune university Square	PMC	Fixed Time Traffic Signal
181.	Bremen Square	PMC	Fixed Time Traffic Signal
182.	Bhale Square	PMC	Fixed Time Traffic Signal
183.	Baner Aundh Road T-junction	PMC	Fixed Time Traffic Signal
184.	Shivaji Housing Society	PMC	Fixed Time Traffic Signal
185.	Patrakarnagar Junction	PMC	Fixed Time Traffic Signal
186.	vetalbaba Square	PMC	Fixed Time Traffic Signal
187.	Deep Bunglow Square	PMC	Fixed Time Traffic Signal
188.	Ambedkar Square DP Road	PMC	Fixed Time Traffic Signal
189.	Suryamukhi Datta Mandir Square	PMC	Fixed Time Traffic Signal
190.	Rajwada Square	PMC	Fixed Time Traffic Signal
191.	Balewadi Junction	PMC	Fixed Time Traffic Signal
192.	Mahabaleshwar Square	PMC	Fixed Time Traffic Signal
193.	Abhimanshri Square	PMC	Fixed Time Traffic Signal
194.	Engineering College Square	PMC	Fixed Time Traffic Signal
195.	Patil Estate Square	PMC	Fixed Time Traffic Signal
196.	Bopodi Square	PMC	Fixed Time Traffic Signal
197.	Ambedkar Square Aundh	PMC	Fixed Time Traffic Signal
198.	Poultry Farm Square	PMC	Fixed Time Traffic Signal
199.	Church Square	PMC	Fixed Time Traffic Signal
200.	Milk Dairy	PMC	Fixed Time Traffic Signal
201.	Dapodi Chowk	PCMC	Fixed Time Traffic Signal
202.	Fugewadi	PCMC	Fixed Time Traffic Signal
203.	Nashik Phata	PCMC	Fixed Time Traffic Signal
204.	Wakhar Mahamandal Panjarpol	PCMC	Fixed Time Traffic Signal
205.	Alandi Road Moshi Chowk	PCMC	Fixed Time Traffic Signal
206.	Bhagwan Mahamandal Dapodi	PCMC	Fixed Time Traffic Signal
207.	Ambedkar Junction	PCMC	Fixed Time Traffic Signal
208.	PCMC Junction Sadguru Nagar	PCMC	Fixed Time Traffic Signal
209.	Shitaladevi Dapodi	PCMC	Fixed Time Traffic Signal
210.	Borade Vasti	PCMC	Fixed Time Traffic Signal

211.	Dehu Phata T Junction	PCMC	Fixed Time Traffic Signal
212.	CAME Dapodi Chowk	PCMC	Fixed Time Traffic Signal
213.	Gajanan Chowk, Spine Road	PCMC	Fixed Time Traffic Signal
214.	Bhosari Fly Over, Bhosari-alandi Chowk	PCMC	Fixed Time Traffic Signal
215.	Fugewadi Underpass	PCMC	Fixed Time Traffic Signal
216.	Atlas Company Underpass	PCMC	Fixed Time Traffic Signal
217.	Kasarwadi Underpass	PCMC	Fixed Time Traffic Signal
218.	Ambedkar Chowk Pimpri	PCMC	Fixed Time Traffic Signal
219.	Ahilyadevi Chowk	PCMC	Fixed Time Traffic Signal
220.	KSB Chowk	PCMC	Fixed Time Traffic Signal
221.	Nehrunagar Chowk, Santoshi Mata	PCMC	Fixed Time Traffic Signal
222.	Shagun Chowk, Sadhu Vasvani	PCMC	Fixed Time Traffic Signal
223.	Maharshi Valmiki Bhatnagar	PCMC	Fixed Time Traffic Signal
224.	Vallabhnagar Subway	PCMC	Fixed Time Traffic Signal
225.	Yashvant Nagar Chowk	PCMC	Fixed Time Traffic Signal
226.	T32 Junction	PCMC	Fixed Time Traffic Signal
227.	Sangavi Phata Chowk	PCMC	Fixed Time Traffic Signal
228.	Rakshak Chowk Junction	PCMC	Fixed Time Traffic Signal
229.	Wakad Y Junction	PCMC	Fixed Time Traffic Signal
230.	Jagtap Dairy Chowk	PCMC	Fixed Time Traffic Signal
231.	Kalewadi Phata	PCMC	Fixed Time Traffic Signal
232.	Hotel Exi. Junction Shitolenagar Sangavi	PCMC	Fixed Time Traffic Signal
233.	Ganapati Junction Shitolenagar	PCMC	Fixed Time Traffic Signal
234.	Shivaar Chowk	PCMC	Fixed Time Traffic Signal
235.	D Mart Chowk	PCMC	Fixed Time Traffic Signal
236.	Tapkir Chowk	PCMC	Fixed Time Traffic Signal
237.	Rahatani Phata	PCMC	Fixed Time Traffic Signal
238.	Govind Garden Chowk	PCMC	Fixed Time Traffic Signal
239.	Javalkar Nagar, Kalptaru Chowk (Swaraj Garden Pimple Gurav)	PCMC	Fixed Time Traffic Signal
240.	MhasobaChowk T Junction	PCMC	Fixed Time Traffic Signal
241.	Swaraj Garden Chowk	PCMC	Fixed Time Traffic Signal
242.	P K Chowk T Junction	PCMC	Fixed Time Traffic Signal
243.	Mahaveer Junction	PCMC	Fixed Time Traffic Signal
244.	Shivaji Junction	PCMC	Fixed Time Traffic Signal
245.	Ahinsa Chowk	PCMC	Fixed Time Traffic Signal
246.	Ravet Chowk	PCMC	Fixed Time Traffic Signal
247.	Mukhai Junction Chowk	PCMC	Fixed Time Traffic Signal
248.	BijliNagar	PCMC	Fixed Time Traffic Signal
249.	Big Bazaar Underpass	PCMC	Fixed Time Traffic Signal
250.	Hotel RiverView Chowk, Chinchwade Chowk	PCMC	Fixed Time Traffic Signal
251.	Bhakti Shakti Junction	PCMC	Fixed Time Traffic Signal
252.	Tilak Chowk	PCMC	Fixed Time Traffic Signal

253.	Khandoba Mal	PCMC	Fixed Time Traffic Signal
254.	Duradevi Chowk	PCMC	Fixed Time Traffic Signal
255.	Triveni Nagar Chowk	PCMC	Fixed Time Traffic Signal
256.	Thermax Junction	PCMC	Fixed Time Traffic Signal
257.	Kachghar Chowk	PCMC	Fixed Time Traffic Signal
258.	Bhel Chowk	PCMC	Fixed Time Traffic Signal
259.	Dhrmaveer Sambhaji Junction	PCMC	Fixed Time Traffic Signal
260.	Mhalsakant Chowk	PCMC	Fixed Time Traffic Signal
261.	Subhash Shinde Chowk, Triveninagar	PCMC	Fixed Time Traffic Signal
262.	Krishan Nagar, Spine Road	PCMC	Fixed Time Traffic Signal
263.	Bajaj Finance Underpass	PCMC	Fixed Time Traffic Signal
264.	Bhumkar Chowk, Kala Khadak Underpass	PCMC	Fixed Time Traffic Signal
265.	Mankar Chowk	PCMC	Fixed Time Traffic Signal
266.	Kaspate Vasti, Y Junction Chowk	PCMC	Fixed Time Traffic Signal
267.	Wakad Octrai Post	PCMC	Fixed Time Traffic Signal
268.	Wakad Gaon Chowk	PCMC	Fixed Time Traffic Signal
269.	Dange Chowk	PCMC	Fixed Time Traffic Signal
270.	Sadanand Chowk, Baner Underpass	PCMC	Fixed Time Traffic Signal
271.	TathWade Chowk	PCMC	Fixed Time Traffic Signal
272.	Birla Hospital	PCMC	Fixed Time Traffic Signal
273.	16 Number Chowk, Wakad Police Line	PCMC	Fixed Time Traffic Signal
274.	Dairy Form, Raghunandan Chowk T Junction	PCMC	Fixed Time Traffic Signal
275.	Punavale Chowk	PCMC	Fixed Time Traffic Signal
276.	Sahara Chowk T Junction	PCMC	Fixed Time Traffic Signal
277.	Balewadi Underpass, Stadium Chowk	PCMC	Fixed Time Traffic Signal
278.	Khane Maruti	PCB	Fixed Time Traffic Signal
279.	Indira Gandhi Chowk	PCB	Fixed Time Traffic Signal
280.	Dorabji Chowk	PCB	Fixed Time Traffic Signal
281.	Lashkar Police Station Chowk	PCB	Fixed Time Traffic Signal
282.	Mahaveer Chowk	PCB	Fixed Time Traffic Signal
283.	Sarbatwala Chowk	PCB	Fixed Time Traffic Signal
284.	Naaz Chowk	PCB	Fixed Time Traffic Signal
285.	Volga Chowk	PCB	Fixed Time Traffic Signal
286.	Pandole Apartment	PCB	Fixed Time Traffic Signal
287.	Mangaldas Vihar	PCB	Fixed Time Traffic Signal
288.	Bhairobanala Chowk	PCB	Fixed Time Traffic Signal
289.	CDA (O) Chowk 1	PCB	Fixed Time Traffic Signal
290.	CDA (O) Chowk 2	PCB	Fixed Time Traffic Signal
291.	Ghadyal Chowk	PCB	Fixed Time Traffic Signal
292.	Golibar Maidan Chowk	PCB	Fixed Time Traffic Signal
293.	Mammadevi Chowk	PCB	Fixed Time Traffic Signal
294.	Turf Club Chowk	PCB	Fixed Time Traffic Signal
295.	Arjun Road Junction	PCB	Fixed Time Traffic Signal

296.	Army Public Chowk	PCB	Fixed Time Traffic Signal
297.	Wanorie Bazaar Chowki	PCB	Fixed Time Traffic Signal
298.	Kahoon Road Junction	PCB	Fixed Time Traffic Signal
299.	Mor Odha Chowk	PCB	Fixed Time Traffic Signal
300.	Mezza 9 Hotel	MIDC	Fixed Time Traffic Signal
301.	Shivaji Chowk	PMC	Fixed Time Traffic Signal
302.	Sambhaji Garden, J M Road	PMC	Pedestrian Signal
303.	Natraj Chowk	PMC	Pedestrian Signal
304.	Kamla Nehru Chowk	PMC	Pedestrian Signal
305.	Yashada	PMC	Pedestrian Signal
306.	Symbiosis College	PMC	Pedestrian Signal
307.	Charurshringi Mandir	PMC	Pedestrian Signal
308.	Kendriya Shala	PMC	Pedestrian Signal
309.	Kamat Hotel	PMC	Pedestrian Signal
310.	Mirch Masala	PMC	Pedestrian Signal
311.	Yashvantrao Natyagruha	PMC	Pedestrian Signal
312.	Sadhu Vasvani	PMC	Pedestrian Signal
313.	Andha Shala	PMC	Pedestrian Signal
314.	Saibaba	PMC	Pedestrian Signal
315.	Sarasbaug	PMC	Pedestrian Signal
316.	K K Market, Near Shankar Math	PMC	Pedestrian Signal
317.	Power House, In Front of Navmaharashtra School	PCMC	Pedestrian Signal
318.	Old D Ward Office	PCMC	Pedestrian Signal
319.	Aundh Hospital Bus Stop	PCMC	Pedestrian Signal
320.	Jagtap Dairy Bus Stop	PCMC	Pedestrian Signal
321.	Fountain Hotel Bus Stop	PCMC	Pedestrian Signal
322.	Kalewadi Phata Bus Stop	PCMC	Pedestrian Signal
323.	Jawalkar Nagar Bus Stop	PCMC	Pedestrian Signal
324.	Vishwashanti Bus Stop	PCMC	Pedestrian Signal
325.	Romeland Nisarg Nirmit Bus Stop	PCMC	Pedestrian Signal
326.	Kokane Bus Stop	PCMC	Pedestrian Signal
327.	Shivaar Bus Stop	PCMC	Pedestrian Signal
328.	Sai Bus Stop	PCMC	Pedestrian Signal
329.	Savitribai Bus Stop	PCMC	Pedestrian Signal
330.	Santosh Nagar Bus Stop	PCMC	Pedestrian Signal
331.	Laxmi Nagar Bus Stop	PCMC	Pedestrian Signal
332.	Pawar Vasti Bus Stop	PCMC	Pedestrian Signal
333.	Punavale Corner Bus Stop	PCMC	Pedestrian Signal
334.	Kaspate Vasti Bus Stop	PCMC	Pedestrian Signal
335.	Sahara Vasti Bus Stop	PCMC	Pedestrian Signal
336.	Marz-O'Rin	PCB	Pedestrian Signal

10.2. List of Proposed Traffic Signals for ATCS

SNo	Name of Junction	Location	No. of Arms	No of Lanes	Polycorbonate Signal Aspects			Galvanized Cantilever poles	Galva nized Stand ard Poles	Pedestrian lamp heads	
					Red	Green	Amber			Stop Man	Walk Man
1	Gotiram Bhaiyya Square	PMC	4	4	8	16	8	4	4	8	8
2	Fad Gate Chowki	PMC	3	3	6	6	6	3	3	4	4
3	Hirabaug Square	PMC	4	4	8	16	8	4	4	8	8
4	Puram Square	PMC	5	6	10	10	10	5	0	0	0
5	Vinoba Bhave Square	PMC	4	4	8	16	8	4	4	8	8
6	SP College Square	PMC	3	3	6	6	6	3	3	4	4
7	Rashtrabhushan Square	PMC	4	4	8	16	8	4	4	8	8
8	Govind Halwai Square	PMC	4	4	8	16	8	4	4	8	8
9	Sant Kabir Square	PMC	4	6	8	16	8	4	4	8	8
10	Ramoshi gate Square	PMC	3	4	6	6	6	3	3	4	4
11	Bhagwan bahubali Square	PMC	4	6	8	16	8	4	4	8	8
12	Narapatgeer Square	PMC	4	4	8	16	8	4	4	8	8
13	Dr. Surendranath Banerjee Square	PMC	3	5	6	6	6	3	3	4	4
14	Hedgewar (Gadgil) Square	PMC	4	5	8	16	8	4	4	8	8
15	Jijamata Square	PMC	4	4	8	16	8	4	4	8	8
16	Budhwar Square	PMC	4	4	8	16	8	4	4	8	8
17	Rameshwar Square	PMC	3	3	6	6	6	3	3	4	4
18	H.M.J Khan Square	PMC	4	4	8	16	8	4	4	8	8
19	Sonya Maruti Square	PMC	4	4	8	16	8	4	4	8	8
20	Belbaug Square	PMC	4	4	8	16	8	4	4	8	8
21	Phadke Haud Square	PMC	4	4	8	16	8	4	4	8	8
22	Kumbhar Vesh Square	PMC	4	7	8	16	8	4	4	8	8

SNo	Name of Junction	Location	No. of Arms	No of Lanes	Polycorbonate Signal Aspects			Galvanized Cantilever poles	Galvanized Standard Poles	Pedestrian lamp heads	
					Red	Green	Amber			Stop Man	Walk Man
23	Seva Sadan Square	PMC	4	8	8	16	8	4	4	8	8
24	Kunte Square	PMC	4	8	8	16	8	4	4	8	8
25	Holkar Square	PMC	4	8	8	16	8	4	4	8	8
26	Umbrya Ganapati Square	PMC	4	8	8	16	8	4	4	8	8
27	Tilak Square	PMC	3	10	6	6	6	3	3	4	4
28	Alka Square	PMC	3	10	6	6	6	3	3	4	4
29	Gadgil Bridge (towards Narayan Peth)	PMC	4	8	8	16	8	4	4	8	8
30	Shanipar Square	PMC	4	8	8	16	8	4	4	8	8
31	Appa Balwant Square	PMC	4	8	8	16	8	4	4	8	8
32	Tilak Smarak/ Badshahi Square	PMC	3	6	6	6	6	3	3	4	4
33	Sahitya Parishad Square	PMC	4	8	8	16	8	4	4	8	8
34	Visava Maruti Square	PMC	4	8	8	16	8	4	4	8	8
35	Shamrav ganjve Square	PMC	4	12	8	16	8	4	4	8	8
36	Senadatta Police Chowki	PMC	3	12	6	6	6	3	3	4	4
37	Takle Haveli Square	PMC	4	8	8	16	8	4	4	8	8
38	New English/ Tilak Square	PMC	4	8	8	16	8	4	4	8	8
39	Khadoji Baba Square	PMC	3	12	6	6	6	3	3	4	4
40	Shelar Mama Square	PMC	3	10	6	6	6	3	3	4	4
41	Yeshwantrao Chavan Bridge Square	PMC	4	11	8	16	8	4	4	8	8
42	Rasashala Square	PMC	4	12	8	16	8	4	4	8	8
43	Swatantyra Square	PMC	3	14	6	6	6	3	3	4	4
44	Prabhat Road T-junction	PMC	3	12	6	6	6	3	3	4	4
45	Bhandarkar T-junction	PMC	3	6	6	6	6	3	3	4	4
46	Natraj Square	PMC	3	10	6	6	6	3	3	4	4

SNo	Name of Junction	Location	No. of Arms	No of Lanes	Polycorbonate Signal Aspects			Galvanized Cantilever poles	Galva nized Stand ard Poles	Pedestrian lamp heads	
					Red	Green	Amber			Stop Man	Walk Man
47	Jhashi Rani Square	PMC	4	16	8	16	8	4	4	8	8
48	Modern High school Square	PMC	3	12	6	6	6	3	3	4	4
49	S.G. Barve Square	PMC	4	12	8	16	8	4	4	8	8
50	Shivaji Statue Square	PMC	4	12	8	16	8	4	4	8	8
51	Premier Garage Square	PMC	3	10	6	6	6	3	3	4	4
52	Khude Square	PMC	4	16	8	16	8	4	4	8	8
53	Sawarkar Bhavan Square	PMC	3	12	6	6	6	3	3	4	4
54	Goodluck SSquare	PMC	4	16	8	16	8	4	4	8	8
55	Tukaram Paduka Square	PMC	3	10	6	6	6	3	3	4	4
56	Fergusson College Square	PMC	3	10	6	6	6	3	3	4	4
57	Dyaneshwar Paduka Square	PMC	4	16	8	16	8	4	4	8	8
58	Sancheti Square	PMC	4	16	8	16	8	4	4	8	8
59	Simla Office Square	PMC	4	16	8	16	8	4	4	8	8
60	Vir Chafekar Square	PMC	4	16	8	16	8	4	4	8	8
61	Varje juncction	PMC	4	8	8	16	8	4	4	8	8
62	Hingne Educational Trust	PMC	4	9	8	16	8	4	4	8	8
63	Nal Stop SSquare	PMC	3	12	6	6	6	3	3	4	4
64	Sahajivan Square	PMC	3	12	6	6	6	3	3	4	4
65	Karve Statue	PMC	3	6	6	6	6	3	3	4	4
66	Hutatma Rajguru Square	PMC	3	14	6	6	6	3	3	4	4
67	Mayur Colony Square	PMC	3	6	6	6	6	3	3	4	4
68	Konkan Express Square	PMC	4	8	8	16	8	4	4	8	8
69	Dahanukar colony Square	PMC	4	8	8	16	8	4	4	8	8
70	Paud Phata(below overbridge)	PMC	4	12	8	16	8	4	4	8	8

SNo	Name of Junction	Location	No. of Arms	No of Lanes	Polycorbonate Signal Aspects			Galvanized Cantilever poles	Galvanized Standard Poles	Pedestrian lamp heads	
					Red	Green	Amber			Stop Man	Walk Man
71	Aathwale Square	PMC	4	10	8	16	8	4	4	8	8
72	Kothrud PMT Depot	PMC	2	4	4	4	4	2	2	2	2
73	Anandnagar Junction	PMC	3	6	6	6	6	3	3	4	4
74	ARAI Kelewadi Junction	PMC	3	10	6	6	6	3	3	4	4
75	Ogle Square	PMC	3	10	6	6	6	3	3	4	4
76	Mahdev Mandir Square	PMC	4	17	8	16	8	4	4	8	8
77	CDSS Square	PMC	4	8	8	16	8	4	4	8	8
78	Karnatak highschoo Square	PMC	3	6	6	6	6	3	3	4	4
79	Paramhans Naagr Square	PMC	2	10	4	4	4	2	2	2	2
80	Gujrat Colony Square	PMC	3	6	6	6	6	3	3	4	4
81	Pushpamangal Square	PMC	4	21	8	16	8	4	4	8	8
82	Rawat Brothers	PMC	4	13	8	16	8	4	4	8	8
83	Sharda Arcade	PMC	3	14	6	6	6	3	3	4	4
84	Chavan Nagar Square	PMC	4	18	8	16	8	4	4	8	8
85	Chandralok Hospital Square	PMC	4	14	8	16	8	4	4	8	8
86	Mahesh Society Square	PMC	4	14	8	16	8	4	4	8	8
87	Annabhau Sathe Square	PMC	3	16	6	6	6	3	3	4	4
88	Balaji Nagar Square	PMC	3	14	6	6	6	3	3	4	4
89	Dhankawdi Phata Square	PMC	3	14	6	6	6	3	3	4	4
90	Padmawati Square	PMC	3	16	6	6	6	3	3	4	4
91	Ahilyadevi Square	PMC	4	16	8	16	8	4	4	8	8
92	Katraj Milk Diray	PMC	3	20	6	6	6	3	3	4	4
93	Katraj Jakat Naka Bypass	PMC	3	14	6	6	6	3	3	4	4
94	Dattanagar Square	PMC	4	10	8	16	8	4	4	8	8

SNo	Name of Junction	Location	No. of Arms	No of Lanes	Polycorbonate Signal Aspects			Galvanized Cantilever poles	Galvanized Standard Poles	Pedestrian lamp heads	
					Red	Green	Amber			Stop Man	Walk Man
95	In front of Katraj Bypass (Satara Road)	PMC	4	21	8	16	8	4	4	8	8
96	Shinde Highschool	PMC	4	8	8	16	8	4	4	8	8
97	Muktangan highschool	PMC	4	8	8	16	8	4	4	8	8
98	Bal Shivaji Square	PMC	3	10	6	6	6	3	3	4	4
99	N.C.Fadke Square	PMC	4	12	8	16	8	4	4	8	8
100	Dandekar bridge Square	PMC	3	13	6	6	6	3	3	4	4
101	Ganesh Square	PMC	3	10	6	6	6	3	3	4	4
102	Rajaram Bridge Square	PMC	3	15	6	6	6	3	3	4	4
103	Sarasbaug (Sawarkar Square)	PMC	4	16	8	16	8	4	4	8	8
104	Shivdarshan Square	PMC	4	8	8	16	8	4	4	8	8
105	mitramandal Square	PMC	3	10	6	6	6	3	3	4	4
106	Navshya Maruti Square	PMC	3	14	6	6	6	3	3	4	4
107	Deepak nitrate/ Big Bazar	PMC	2	12	4	4	4	2	2	2	2
108	Gajanan Maharaj	PMC	4	8	8	16	8	4	4	8	8
109	Vishranti Nagar	PMC	3	14	6	6	6	3	3	4	4
110	Hingne	PMC	4	14	8	16	8	4	4	8	8
111	Santosh Hall	PMC	4	16	8	16	8	4	4	8	8
112	Brahma Hotel	PMC	5	13	10	10	10	5	0	0	0
113	Vadgaon Bridge	PMC	4	16	8	16	8	4	4	8	8
114	Jedhe Square	PMC	4	7	8	16	8	4	4	8	8
115	Holga Square	PMC	4	10	8	16	8	4	4	8	8
116	Panchami Square	PMC	3	7	6	6	6	3	3	4	4
117	Market Yard Square	PMC	3	7	6	6	6	3	3	4	4
118	Gangadham junction	PMC	4	8	8	16	8	4	4	8	8

SNo	Name of Junction	Location	No. of Arms	No of Lanes	Polycorbonate Signal Aspects			Galvanized Cantilever poles	Galvanized Standard Poles	Pedestrian lamp heads	
					Red	Green	Amber			Stop Man	Walk Man
119	Seven Loves Square	PMC	4	8	8	16	8	4	4	8	8
120	Dayra Plot Square	PMC	4	11	8	16	8	4	4	8	8
121	Giridhar Bhavan Sqaure	PMC	4	8	8	16	8	4	4	8	8
122	Vega Center	PMC	3	6	6	6	6	3	3	4	4
123	Dhobi Ghat	PMC	4	8	8	16	8	4	4	8	8
124	Vakhar Mahamandal	PMC	3	6	6	6	6	3	3	4	4
125	Lulla Nagar Square	PMC	4	10	8	16	8	4	4	8	8
126	Khadi Machine Square	PMC	3	6	6	6	6	3	3	4	4
127	Jambhulkar Square	PMC	4	9	8	16	8	4	4	8	8
128	Fatimanagar Square	PMC	3	11	6	6	6	3	3	4	4
129	Sopanbaug Square	PMC	3	6	6	6	6	3	3	4	4
130	Ramtekdi Square	PMC	3	9	6	6	6	3	3	4	4
131	Solapur Bazar	PMC	3	7	6	6	6	3	3	4	4
132	Vaiduvadi Square	PMC	3	9	6	6	6	3	3	4	4
133	Hadapsar Bajar Square	PMC	3	7	6	6	6	3	3	4	4
134	Magarpatta junction	PMC	3	9	6	6	6	3	3	4	4
135	Magarpatta Main Gate	PMC	3	4	6	6	6	3	3	4	4
136	Amanora Park	PMC	3	4	6	6	6	3	3	4	4
137	Keshav Naagr mudhwa junction	PMC	4	16	8	16	8	4	4	8	8
138	Bund Garden	PMC	4	12	8	16	8	4	4	8	8
139	North main Road	PMC	3	12	6	6	6	3	3	4	4
140	Blue Diamond Square	PMC	3	12	6	6	6	3	3	4	4
141	Boat club Square/ Hemant Karkare Square	PMC	3	10	6	6	6	3	3	4	4
142	Moboj Square	PMC	4	14	8	16	8	4	4	8	8

SNo	Name of Junction	Location	No. of Arms	No of Lanes	Polycorbonate Signal Aspects			Galvanized Cantilever poles	Galvanized Standard Poles	Pedestrian lamp heads	
					Red	Green	Amber			Stop Man	Walk Man
143	mangaldas Square	PMC	3	12	6	6	6	3	3	4	4
144	Jahangir Square	PMC	3	12	6	6	6	3	3	4	4
145	ABC Farms	PMC	3	12	6	6	6	3	3	4	4
146	Tadigutta Square	PMC	3	16	6	6	6	3	3	4	4
147	RTO Square	PMC	4	16	8	16	8	4	4	8	8
148	Alankar Square	PMC	4	14	8	16	8	4	4	8	8
149	Pune Station Square	PMC	3	12	6	6	6	3	3	4	4
150	blue nile Square	PMC	4	14	8	16	8	4	4	8	8
151	Bolhai Sqaure	PMC	4	16	8	16	8	4	4	8	8
152	IB Square	PMC	4	14	8	16	8	4	4	8	8
153	Council Hall Square	PMC	4	16	8	16	8	4	4	8	8
154	Maldhakka Square	PMC	4	16	8	16	8	4	4	8	8
155	Shahir Amarsheikh Square	PMC	4	16	8	16	8	4	4	8	8
156	Nehru memorial hall Square	PMC	3	12	6	6	6	3	3	4	4
157	Parnakuti Square	PMC	3	8	6	6	6	3	3	4	4
158	Shastrinagar Square	PMC	3	12	6	6	6	3	3	4	4
159	Kalyani nagar Junction	PMC	4	16	8	16	8	4	4	8	8
160	Gunjan Square	PMC	3	12	6	6	6	3	3	4	4
161	Golf Club SSquare	PMC	3	12	6	6	6	3	3	4	4
162	Gold Adlabs	PMC	4	16	8	16	8	4	4	8	8
163	Commerce Zone Company	PMC	4	8	8	16	8	4	4	8	8
164	Yerwada Jail Junction	PMC	3	10	6	6	6	3	3	4	4
165	Ambedkar Society	PMC	3	12	6	6	6	3	3	4	4
166	Tarkeshwar Square	PMC	3	10	6	6	6	3	3	4	4

SNo	Name of Junction	Location	No. of Arms	No of Lanes	Polycorbonate Signal Aspects			Galvanized Cantilever poles	Galvanized Standard Poles	Pedestrian lamp heads	
					Red	Green	Amber			Stop Man	Walk Man
167	Sadalbaba Square	PMC	4	16	8	16	8	4	4	8	8
168	Garrison Engineering	PMC	4	12	8	16	8	4	4	8	8
169	Viman Nagar Junction	PMC	3	12	6	6	6	3	3	4	4
170	Vadgaon Sheri	PMC	3	12	6	6	6	3	3	4	4
171	Tata Gaurdroom Square	PMC	4	16	8	16	8	4	4	8	8
172	Somnath Nagar	PMC	3	6	6	6	6	3	3	4	4
173	Kharadi Bypass	PMC	3	12	6	6	6	3	3	4	4
174	Chadrama Square	PMC	3	12	6	6	6	3	3	4	4
175	Dighi Magazine	PMC	4	16	8	16	8	4	4	8	8
176	Parihar Square	PMC	4	8	8	16	8	4	4	8	8
177	Range Hills Square	PMC	3	6	6	6	6	3	3	4	4
178	Rishi Malhotra Square	PMC	3	6	6	6	6	3	3	4	4
179	SB Raod t junction	PMC	4	8	8	16	8	4	4	8	8
180	Pune university Square	PMC	3	6	6	6	6	3	3	4	4
181	Bremen Square	PMC	3	6	6	6	6	3	3	4	4
182	Bhale Square	PMC	3	6	6	6	6	3	3	4	4
183	Baner Aundh Road T-junction	PMC	4	8	8	16	8	4	4	8	8
184	Shivaji Housing Society	PMC	3	6	6	6	6	3	3	4	4
185	Patrakarnagar Junction	PMC	4	7	8	16	8	4	4	8	8
186	vetalbaba Square	PMC	3	6	6	6	6	3	3	4	4
187	Deep Bunglow Square	PMC	4	8	8	16	8	4	4	8	8
188	Ambedkar Square DP Road	PMC	4	8	8	16	8	4	4	8	8
189	Suryamukhi Datta Mandir Square	PMC	4	8	8	16	8	4	4	8	8
190	Rajwada Square	PMC	4	8	8	16	8	4	4	8	8

SNo	Name of Junction	Location	No. of Arms	No of Lanes	Polycorbonate Signal Aspects			Galvanized Cantilever poles	Galvanized Standard Poles	Pedestrian lamp heads	
					Red	Green	Amber			Stop Man	Walk Man
191	Balewadi Junction	PMC	3	6	6	6	6	3	3	4	4
192	Mahabaleshwar Square	PMC	3	5	6	6	6	3	3	4	4
193	Abhimanshri Square	PMC	3	5	6	6	6	3	3	4	4
194	Engineering College Square	PMC	5	7	10	10	10	5	0	0	0
195	Patil Estate Square	PMC	3	5	6	6	6	3	3	4	4
196	Bopodi Square	PMC	3	6	6	6	6	3	3	4	4
197	Ambedkar Square Aundh	PMC	3	6	6	6	6	3	3	4	4
198	Poultry Farm Square	PMC	3	6	6	6	6	3	3	4	4
199	Church Square	PMC	4	8	8	16	8	4	4	8	8
200	Milk Dairy	PMC	3	6	6	6	6	3	3	4	4
201	Prabhat Road Gully number 8	PMC	4	12	8	16	8	4	4	8	8
202	Hare krushna Road, Katraj	PMC	3	12	6	6	6	3	3	4	4
203	Shivaji Chowk	PMC	4	6	8	16	8	4	4	8	8
204	Shivshakti Road, SuS Raod Sutarwadi	PMC	3	10	6	6	6	3	3	4	4
205	V.S. Khandekar square	PMC	3	12	6	6	6	3	3	4	4
206	Balaji Square	PMC	4	12	8	16	8	4	4	8	8
207	Navle Square	PMC	3	12	6	6	6	3	3	4	4
208	Ganraj Mangal Karyalay Square	PMC	4	20	8	16	8	4	4	8	8
209	Datta Nagar Junction	PMC	4	16	8	16	8	4	4	8	8
210	Dorabji Mall Junctions	PMC	3	12	6	6	6	3	3	4	4
211	Mauli Petrol pump	PMC	2	4	4	4	4	2	2	2	2
212	Symbiosis International School	PMC	3	12	6	6	6	3	3	4	4
213	DSK Ranwara Square	PMC	3	10	6	6	6	3	3	4	4
214	Aranyeshwar Square	PMC	4	16	8	16	8	4	4	8	8

SNo	Name of Junction	Location	No. of Arms	No of Lanes	Polycorbonate Signal Aspects			Galvanized Cantilever poles	Galvanized Standard Poles	Pedestrian lamp heads	
					Red	Green	Amber			Stop Man	Walk Man
215	Rajas Socity Square	PMC	4	18	8	16	8	4	4	8	8
216	Somnath Nagar Square	PMC	3	6	6	6	6	3	3	4	4
217	Kirad Square	PMC	4	8	8	16	8	4	4	8	8
218	Gaganvihar Junction	PMC	3	12	6	6	6	3	3	4	4
219	Benkar Square	PMC	3	6	6	6	6	3	3	4	4
220	Gokulnagar junction	PMC	3	10	6	6	6	3	3	4	4
221	Bankar Square	PMC	3		6	6	6	3	3	4	4
222	Lalit Mahal Square	PMC	3	10	6	6	6	3	3	4	4
223	Manjri Fata Solapur Road	PMC	3	10	6	6	6	3	3	4	4
224	CCD Square	PMC	4	12	8	16	8	4	4	8	8
225	Tekwade Petrol pump, Seasons mall	PMC	3	14	6	6	6	3	3	4	4
226	Ganagapuram Society junction	PMC	3	10	6	6	6	3	3	4	4
227	Tukai Darshan Square	PMC	3	12	6	6	6	3	3	4	4
228	Shri Krishna Hotel Square	PMC	3	16	6	6	6	3	3	4	4
229	Panchawati junction Square	PMC	3	11	6	6	6	3	3	4	4
230	Kalubai Square	PMC	2	8	4	4	4	2	2	2	2
231	Sai Square Poultry underpass	PMC	3	16	6	6	6	3	3	4	4
232	Kalepadal Corner, Square	PMC	3	6	6	6	6	3	3	4	4
233	Dapodi Chowk	PCMC	3	8	6	6	6	3	3	4	4
234	Fugewadi	PCMC	3	12	6	6	6	3	3	4	4
235	Nashik Phata	PCMC	3	16	6	6	6	3	3	4	4
236	Wakhar Mahamandal Panjarpol	PCMC	4	14	8	16	8	4	4	8	8
237	Alandi Road Moshi Chowk	PCMC	3	6	6	6	6	3	3	4	4
238	Bhagwan Mahamandal Dapodi	PCMC	2	8	4	4	4	2	2	2	2

SNo	Name of Junction	Location	No. of Arms	No of Lanes	Polycorbonate Signal Aspects			Galvanized Cantilever poles	Galvanized Standard Poles	Pedestrian lamp heads	
					Red	Green	Amber			Stop Man	Walk Man
239	Ambedkar Junction	PCMC	3	8	6	6	6	3	3	4	4
240	PCMC Junction Sadguru Nagar	PCMC	3	6	6	6	6	3	3	4	4
241	Shitaladevi Dapodi	PCMC	3	12	6	6	6	3	3	4	4
242	Borade Vasti	PCMC	3	6	6	6	6	3	3	4	4
243	Dehu Phata T Junction	PCMC	4	16	8	16	8	4	4	8	8
244	CAME Dapodi Chowk	PCMC	2	10	4	4	4	2	2	2	2
245	Gajanan Chowk, Spine Road	PCMC	4	8	8	16	8	4	4	8	8
246	Bhosari Fly Over, Bhosari-alandi Chowk	PCMC	4	12	8	16	8	4	4	8	8
247	Fugewadi Underpass	PCMC	2	4	4	4	4	2	2	2	2
248	Atlas Company Underpass	PCMC	2	4	4	4	4	2	2	2	2
249	Kasarwadi Underpass	PCMC	4	12	8	16	8	4	4	8	8
250	Ambedkar Chowk Pimpri	PCMC	4	12	8	16	8	4	4	8	8
251	Ahilyadevi Chowk	PCMC	4	12	8	16	8	4	4	8	8
252	KSB Chowk	PCMC	4	10	8	16	8	4	4	8	8
253	Nehrunagar Chowk, Santoshi Mata	PCMC	4	12	8	16	8	4	4	8	8
254	Shagun Chowk, Sadhu Vasvani	PCMC	4	8	8	16	8	4	4	8	8
255	Maharshi Valmiki Bhatnagar	PCMC	4	8	8	16	8	4	4	8	8
256	Vallabhnagar Subway	PCMC	4	12	8	16	8	4	4	8	8
257	Yashvant Nagar Chowk	PCMC	4	18	8	16	8	4	4	8	8
258	T32 Junction	PCMC	3	6	6	6	6	3	3	4	4
259	Sangavi Phata Chowk	PCMC	4	7	8	16	8	4	4	8	8
260	Rakshak Chowk Junction	PCMC	4	10	8	16	8	4	4	8	8
261	Wakad Y Junction	PCMC	3	2	6	6	6	3	3	4	4
262	Jagtap Dairy Chowk	PCMC	4	12	8	16	8	4	4	8	8

SNo	Name of Junction	Location	No. of Arms	No of Lanes	Polycorbonate Signal Aspects			Galvanized Cantilever poles	Galva nized Stand ard Poles	Pedestrian lamp heads	
					Red	Green	Amber			Stop Man	Walk Man
263	Kalewadi Phata	PCMC	4	11	8	16	8	4	4	8	8
264	Hotel Exi. Junction Shitolenagar Sangavi	PCMC	3		6	6	6	3	3	4	4
265	Ganapati Junction Shitolenagar	PCMC	3		6	6	6	3	3	4	4
266	Shivaar Chowk	PCMC	4	10	8	16	8	4	4	8	8
267	D Mart Chowk	PCMC	3	7	6	6	6	3	3	4	4
268	Tapkir Chowk	PCMC	3	8	6	6	6	3	3	4	4
269	Rahatani Phata	PCMC	3	8	6	6	6	3	3	4	4
270	Govind Garden Chowk	PCMC	3	6	6	6	6	3	3	4	4
271	Javalkar Nagar, Kalptaru Chowk (Swaraj Garden Pimple Gurav)	PCMC	4	10	8	16	8	4	4	8	8
272	MhasobaChowk T Junction	PCMC	3	8	6	6	6	3	3	4	4
273	Swaraj Garden Chowk	PCMC	3	8	6	6	6	3	3	4	4
274	P K Chowk T Junction	PCMC	4	10	8	16	8	4	4	8	8
275	Mahaveer Junction	PCMC	4	20	8	16	8	4	4	8	8
276	Shivaji Junction	PCMC	4	24	8	16	8	4	4	8	8
277	Ahinsa Chowk	PCMC	4	12	8	16	8	4	4	8	8
278	Ravet Chowk	PCMC	2	8	4	4	4	2	2	2	2
279	Mukhai Junction Chowk	PCMC	4	16	8	16	8	4	4	8	8
280	BijliNagar	PCMC	4	12	8	16	8	4	4	8	8
281	Big Bazaar Underpass	PCMC	4	12	8	16	8	4	4	8	8
282	Hotel RiverView Chowk, Chinchwade Chowk	PCMC	3	12	6	6	6	3	3	4	4
283	Bhakti Shakti Junction	PCMC	4	24	8	16	8	4	4	8	8
284	Tilak Chowk	PCMC	4	20	8	16	8	4	4	8	8
285	Khandoba Mal	PCMC	5	24	10	10	10	5	0	0	0

SNo	Name of Junction	Location	No. of Arms	No of Lanes	Polycorbonate Signal Aspects			Galvanized Cantilever poles	Galvanized Standard Poles	Pedestrian lamp heads	
					Red	Green	Amber			Stop Man	Walk Man
286	Duradevi Chowk	PCMC	4	16	8	16	8	4	4	8	8
287	Triveni Nagar Chowk	PCMC	5	18	10	10	10	5	0	0	0
288	Thermax Junction	PCMC	4	20	8	16	8	4	4	8	8
289	Kachghar Chowk	PCMC	4	20	8	16	8	4	4	8	8
290	Bhel Chowk	PCMC	4	20	8	16	8	4	4	8	8
291	Dhrmaveer Sambhaji Junction	PCMC	4	16	8	16	8	4	4	8	8
292	Mhalsakant Chowk	PCMC	4	16	8	16	8	4	4	8	8
293	Subhash Shinde Chowk, Triveninagar	PCMC	3		6	6	6	3	3	4	4
294	Krishan Nagar, Spine Road	PCMC	4	20	8	16	8	4	4	8	8
295	Bajaj Finance Underpass	PCMC	4	20	8	16	8	4	4	8	8
296	Bhumkar Chowk, Kala Khadak Underpass	PCMC	4	18	8	16	8	4	4	8	8
297	Mankar Chowk	PCMC	3	10	6	6	6	3	3	4	4
298	Kaspate Vasti, Y Junction Chowk	PCMC	3	10	6	6	6	3	3	4	4
299	Wakad Octrai Post	PCMC	4	20	8	16	8	4	4	8	8
300	Wakad Gaon Chowk	PCMC	4	13	8	16	8	4	4	8	8
301	Dange Chowk	PCMC	4	12	8	16	8	4	4	8	8
302	Sadanand Chowk, Baner Underpass	PCMC	3	6	6	6	6	3	3	4	4
303	TathWade Chowk	PCMC	3	9	6	6	6	3	3	4	4
304	Birla Hospital	PCMC	3	5	6	6	6	3	3	4	4
305	16 Number Chowk, Wakad Police Line	PCMC	3	10	6	6	6	3	3	4	4
306	Dairy Form, Raghunandan Chowk T Junction	PCMC	3	9	6	6	6	3	3	4	4
307	Punavale Chowk	PCMC	3	7	6	6	6	3	3	4	4

SNo	Name of Junction	Location	No. of Arms	No of Lanes	Polycorbonate Signal Aspects			Galvanized Cantilever poles	Galvanized Standard Poles	Pedestrian lamp heads	
					Red	Green	Amber			Stop Man	Walk Man
308	Sahara Chowk T Junction	PCMC	3	12	6	6	6	3	3	4	4
309	Balewadi Underpass, Stadium Chowk	PCMC	3	6	6	6	6	3	3	4	4
310	Sambhaji Garden, J M Road	PMC	4	12	8	16	8	4	4	8	8
311	Natraj Chowk	PMC	3	10	6	6	6	3	3	4	4
312	Kamla Nehru Chowk	PMC	4	7	8	16	8	4	4	8	8
313	Yashada	PMC	4	8	8	16	8	4	4	8	8
314	Symbiosis College	PMC	4	11	8	16	8	4	4	8	8
315	Charurshringi Mandir	PMC	2	4	4	4	4	2	2	2	2
316	Kendriya Shala	PMC	4	14	8	16	8	4	4	8	8
317	Kamat Hotel	PMC	4	11	8	16	8	4	4	8	8
318	Mirch Masala	PMC	2	8	4	4	4	2	2	2	2
319	Yashvantrao Natyagruha	PMC	2	4	4	4	4	2	2	2	2
320	Sadhu Vasvani	PMC	4	14	8	16	8	4	4	8	8
321	Andha Shala	PMC	4	16	8	16	8	4	4	8	8
322	Saibaba	PMC	3	16	6	6	6	3	3	4	4
323	Sarasbaug	PMC	3	12	6	6	6	3	3	4	4
324	K K Market, Near Shankar Math	PMC	4	16	8	16	8	4	4	8	8
325	Marz-O'Rin	PCB	4	8	8	16	8	4	4	8	8
326	Power House, In Front of Navmaharashtra School	PCMC	3		6	6	6	3	3	4	4
327	Old D Ward Office	PCMC	3		6	6	6	3	3	4	4
328	Aundh Hospital Bus Stop	PCMC	3	8	6	6	6	3	3	4	4
329	Jagtap Dairy Bus Stop	PCMC	4	16	8	16	8	4	4	8	8
330	Fountain Hotel Bus Stop	PCMC	2	8	4	4	4	2	2	2	2
331	Kalewadi Phata Bus Stop	PCMC	4	14	8	16	8	4	4	8	8

SNo	Name of Junction	Location	No. of Arms	No of Lanes	Polycorbonate Signal Aspects			Galvanized Cantilever poles	Galvanized Standard Poles	Pedestrian lamp heads	
					Red	Green	Amber			Stop Man	Walk Man
332	Jawalkar Nagar Bus Stop	PCMC	3	10	6	6	6	3	3	4	4
333	Vishwashanti Bus Stop	PCMC	4	12	8	16	8	4	4	8	8
334	Romeland Nisarg Nirmit Bus Stop	PCMC	2	4	4	4	4	2	2	2	2
335	Kokane Bus Stop	PCMC	4	10	8	16	8	4	4	8	8
336	Shivaar Bus Stop	PCMC	4	12	8	16	8	4	4	8	8
337	Sai Bus Stop	PCMC	4	16	8	16	8	4	4	8	8
338	Savitribai Bus Stop	PCMC	4	16	8	16	8	4	4	8	8
339	Santosh Nagar Bus Stop	PCMC	3		6	6	6	3	3	4	4
340	Laxmi Nagar Bus Stop	PCMC	3	6	6	6	6	3	3	4	4
341	Pawar Vasti Bus Stop	PCMC	2	4	4	4	4	2	2	2	2
342	Punavale Corner Bus Stop	PCMC	4	9	8	16	8	4	4	8	8
343	Kaspate Vasti Bus Stop	PCMC	3	10	6	6	6	3	3	4	4
344	Sahara Vasti Bus Stop	PCMC	4	14	8	16	8	4	4	8	8
345	Mezza 9 Hotel	MIDC	3	6	6	6	6	3	3	4	4
346	Shivaji Chowk	MIDC	4	9	8	16	8	4	4	8	8
347	Khane Maruti	PCB	4	5	8	16	8	4	4	8	8
348	Indira Gandhi Chowk	PCB	4	8	8	16	8	4	4	8	8
349	Dorabji Chowk	PCB	4	7	8	16	8	4	4	8	8
350	Lashkar Police Station Chowk	PCB	4	8	8	16	8	4	4	8	8
351	Mahaveer Chowk	PCB	4	6	8	16	8	4	4	8	8
352	Sarbatwala Chowk	PCB	4	6	8	16	8	4	4	8	8
353	Naaz Chowk	PCB	4	8	8	16	8	4	4	8	8
354	Volga Chowk	PCB	4	7	8	16	8	4	4	8	8
355	Pandole Apartment	PCB	4	4	8	16	8	4	4	8	8

SNo	Name of Junction	Location	No. of Arms	No of Lanes	Polycorbonate Signal Aspects			Galvanized Cantilever poles	Galvanized Standard Poles	Pedestrian lamp heads	
					Red	Green	Amber			Stop Man	Walk Man
356	Mangaldas Vihar	PCB	3	3	6	6	6	3	3	4	4
357	Bhairobanala Chowk	PCB	4	9	8	16	8	4	4	8	8
358	CDA (O) Chowk 1	PCB	3	9	6	6	6	3	3	4	4
359	CDA (O) Chowk 2	PCB	3	6	6	6	6	3	3	4	4
360	Ghadyal Chowk	PCB	3		6	6	6	3	3	4	4
361	Golibar Maidan Chowk	PCB	4	10	8	16	8	4	4	8	8
362	Mammadevi Chowk	PCB	4	12	8	16	8	4	4	8	8
363	Turf Club Chowk	PCB	4	7	8	16	8	4	4	8	8
364	Arjun Road Junction	PCB	3	6	6	6	6	3	3	4	4
365	Army Public Chowk	PCB	4	8	8	16	8	4	4	8	8
366	Wanorie Bazaar Chowki	PCB	3	5	6	6	6	3	3	4	4
367	Kahoon Road Junction	PCB	3	10	6	6	6	3	3	4	4
368	Mor Odha Chowk	PCB	3	10	6	6	6	3	3	4	4
	Totals		**1281**	**3725**	**2562**	**4026**	**2562**	**1281**	**1256**	**2152**	**2152**

10.3. List of Proposed Red Light Violation Detection (RLVD) Locations

S. No.	Junction Name	Number of Arms	Number of Lanes				
			Arm 1	Arm 2	Arm 3	Arm 4	Arm 5
1.	Puram Square	5	2	1	1	1	1
2.	Narapatgeer Square	4	1	1	1	1	NA
3.	Belbaug Square	4	1	1	1	1	NA
4.	Alka Square	3	4	4	2	NA	NA
5.	Appa Balwant Square	4	2	2	2	2	NA
6.	Khadoji Baba Square	3	4	4	4	NA	NA
7.	Jhashi Rani Square	4	4	4	4	4	NA
8.	Goodluck SSquare	4	4	4	4	4	NA
9.	Simla Office Square	4	4	4	4	4	NA
10.	Nal Stop Square	3	1	3	2	NA	NA
11.	Kurve Putla Chowk	3	1	1	1	NA	NA
12.	Paud Phata(below overbridge)	4	2	1	3	NA	NA
13.	Ahilyadevi Square	4	2	6	2	6	NA
14.	In front of Katraj Bypass (Satara Road)	4	7	6	6	2	NA
15.	Sarasbaug (Sawarkar Square)	3	4	4	4	NA	NA
16.	Market Yard Square	3	2	2	3	NA	NA
17.	Fatimanagar Square	3	5	1	5	NA	NA
18.	Keshav Naagr mudhwa junction	4	4	4	4	4	NA
19.	North main Road	3	4	4	4	NA	NA
20.	RTO Square	4	4	4	4	4	NA
21.	Maldhakka Square	4	4	4	4	4	NA
22.	Shahir Amarsheikh Square	4	4	4	4	4	NA
23.	Shastrinagar Square	3	4	4	4	NA	NA
24.	Gunjan Square	3	4	4	4	NA	NA
25.	Kharadi Bypass	3	4	4	4	NA	NA
26.	Pune university Square	3	2	2	2	NA	NA
27.	Balewadi Underpass, Stadium Chowk	3	2	2	2	NA	NA
28.	KSB Chowk	4	3	2	1	4	NA
29.	Jagtap Dairy Chowk	4	6	6	6	4	NA
30.	Kalewadi Phata	3	4	2	4	NA	NA
31.	Thermax Junction	4	4	6	4	6	NA
32.	Kaspate Vasti, Y Junction Chowk	3	4	4	2	NA	NA
33.	Dange Chowk	4	2	4	2	4	NA