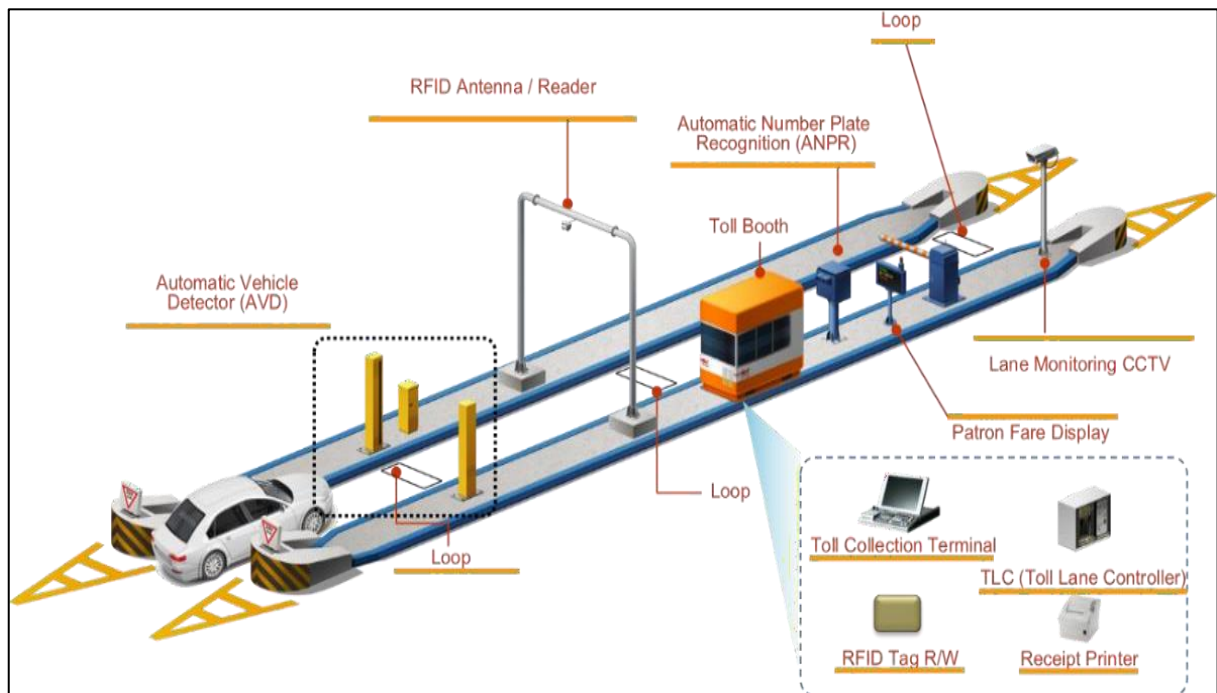


INSTALLATION OF TOLL MANAGEMENT SYSTEM ON NAGPUR MUMBAI SUPER COMMUNICATION HIGHWAY



ELECTRONIC TOLL COLLECTION SYSTEM FOR NMSCEW

DECEMBER 2020

INSTALLATION OF TOLL MANAGEMENT SYSTEM

AT TOLL PLAZAS OF NMSCEL

1. Closed System of Toll Collection

Closed System of Toll Collection shall be adopted at NMSCE wherein payment needs to be made only at the exit by either charging the same through the RFID tag of the passing vehicle or depositing the ticket collected at the entry.

The closed toll system shall have entry and exit booths at each entry and exit point of the expressway for the toll system to capture all user details and charge their fee as per the class of vehicle and the distance travelled. Upon entering the Toll System, the RFID on the user vehicle is read. In case of manual/ smart card collection system, the user receives a ticket. When exiting, the user gives the ticket to the toll collector and is charged the fee. In case of ETC system, the amount is debited from the user's prepaid account.

Electronic Toll Collection (ETC) system shall be installed for collection of toll/fee with cash or smart card as a backup.

2. Technical Specifications & Standards

The minimum technical specifications & the standards that need to be adhered have been mentioned in this document which has been compiled in accordance with IRC:SP:99-2013.

3. ETC Equipment.

Following equipment shall be provided at the toll plazas:

3.1 Lane Level.

S. No	Equipment Description	Unit	Qty per Toll lane
1	RFID ETC transceiver	Nos.	1
2	Toll Lane Controller with Industrial PC (TLC)	Nos.	1
3	AVCC including sensors, loop and detector	Set	1
4	User Fare Display with mounting pole (UFD)	Set	1
5	Automatic Boom Barrier (ABB)	Nos.	1
6	Overhead Lane Status light (OHLS)	Nos.	1
7	Traffic light with mounting pole (TL)	Nos.	1
8	Loops with detector	Set	2

S. No	Equipment Description	Unit	Qty per Toll lane
9	Incident Capture Camera with mounting pole (ICS)	Set	1
10	License Plate Image Capture Camera with mounting poles (LPICC)	Set	1
11	Toll Collector Display - TFT Monitor	Nos.	1
12	Customized industrial grade Keyboard	Nos.	1
13	Thermal Receipt Printer	Nos.	1
14	Bar Code Reader (BCR)	Nos.	1
15	Cash Drawer	Nos.	1
16	Manual Booth Controller	Nos.	1
17	Violation light & Alarm and Foot switch in booth	Nos.	1
18	Booth CCTV camera	Nos.	1
19	Cabling/ Networking/ Installation/ Commissioning	Lump sum	1
20	Software - Lane Level	Job	1
21	Intercom Slave unit in booth	Nos.	1
22	Lane Level UPS (2 KVA)	Nos	1
23	8 Port / 24 Port Network Switch (Layer 3)	Nos	01 per toll plaza
24	RFID Handheld Readers with Wi-Fi connectivity	Nos.	01 per 03 lanes
25	Industrial grade outdoor Wi-Fi Access Points	Nos.	As per site requirements
26	Medium Speed Weigh in Motion (MSWIM)- 3 mtr, including vehicle separator, Loop & Detector and Junction Box.	Nos.	01 per Entry Plaza
27	Static Weigh Bridge	Nos.	01 per Entry Plaza.

Note:

In compliance to requirements of IRC:SP:99-2013, 02 middle lanes shall be capable of being used as reversible lanes to meet the demand of tidal traffic flow. One additional lane on either side shall be provided for over dimensioned vehicles.

3.2 Toll Office Level

S. No.	Equipment Description	Unit	Qty per Toll Office
1	Plaza Server in Hot Standby Configuration	Nos.	1
2	42U Server Rack with front door having glass APW	Nos.	1
3	Workstations for MIS, Cashup, Audit & LSDU System (in control room)	Nos.	4
4	Network Printer	Nos.	1
5	24 Port Network switch (Layer 3)	Nos.	1
6	Software – Plaza level	Job	1
7	Broadband Internet connection with 1 Public IP of minimum 6 Mbps link for CCH connectivity	Nos.	1
8	Internet Router for connection with CCH	Nos.	1
9	Network Firewall Hardware	Nos.	1
10	UPS as per power requirement calculations for Toll Office Systems	Nos.	1
11	Network Video Recorder (NVR) for CCTV recording with 30 days of storage. with 55” display monitor	Nos	1
12	55” LED display for CCTV monitoring	Nos.	1
13	CCTV cameras for Plaza building surveillance (server room, control room, cash room, admin room, tunnels, etc.)	Nos.	6
14	Master Intercom System	Nos.	1

3.3 Transaction Data Format:

Minimum data that makes up an ETC transaction is as follows:

- a. Transaction ID
- b. Tag ID (TID, EPC, and User Memory)
- c. Plaza and Lane ID
- d. Date and Time Stamp
- e. AVCC Class
- f. Image of vehicle (JPEG)

3.4. **Transaction Processing**

The System needs to have the following capability:

- a. Have functionality to feed in transaction data through RFID ETC transceiver, Hand-held devices and manual entry of Registration No. of vehicles.
- b. Validate each transaction for completeness (e.g. possessing all the related information like Tag ID, Vehicle class, etc.).
- c. Check for duplicate transactions (e.g. the same tag cannot be used in the same direction within a specified duration at the same plaza).
- d. Support generation of reports as given below but not limited to:
 - i. Revenue reports.
 - ii. Traffic reports (Lane wise all mode of traffic report).
 - iii. Penalty Collection report lane wise.
 - iv. Daily / Weekly / Monthly reconciliation reports.
 - v. Violation reports.
 - vi. AVCC Accuracy Report.
 - vii. Separate ETC report for Handheld RFID reader.
 - viii. Equipment uptime reports (RFID Reader, AVCC, TLC, LPICC, ICS and Server).
- e. **Security:**
 - i. Login feature for accessing the System.
 - ii. Access the system based on roles definition.
 - iii. Storage of sensitive data like password in an encrypted format.
 - iv. Use of Complicated passwords: password should be more than 6 characters and should have at least one numeric character.
 - v. Automatic logging of every sensitive action in the system.
- f. **Scalability**

The System / Servers need to be scalable to support increase in Tag Users / ETC transactions in future. During the time of system commissioning each lane of the system shall be capable to support 5 million tag users and 30,000 (Thirty thousand) transactions per day.

4. **System Configuration**

The minimum functional and technical specifications for hardware that needs to be used in Toll Collection System is given below:

5. **ETC RFID Transceiver**

Each ETC lane is to have one RFID Transceiver. The RFID Transceiver is to be mounted on canopy

5.1 Specifications.

Description	Specifications
RF/ Radio:	
Frequency	UHF 865 to 867 MHz
Communications	Ethernet/ Serial communication (EIA standard RS 232 C/ RS 485)
RF Power Maximum	1W - transmitted and 4W- EIRP (Equivalent Isotropically Radiated Power)
Reading distance	With the transceiver mounted typically at a height of 6m above the road surface, the coverage of the antenna shall not exceed a diameter of 3.6m
Antenna	Circularly/ Linear polarized
Protocol	EPC Gen 2, ISO 18000-6C and shall comply with the general conformance requirements of the standard. Alien Higgs3 (Block Read Lock) NXP UCODE G2II (EAS) NXP UCODE DNA (AES)
Visual diagnostics	The transceiver shall have LED indicators for sense, transmit Fault and Power which shall be visible clearly to the operator on ground while the system is operational.
Environmental:	
Enclosure	Lightweight enclosure for the RFID Transceiver and circularly/ linearly polarised antenna.
Environmental	IP 65 or better for outdoor units.
Relative Humidity	95% Condensing
Operating Temperature	-20°C to 55°C
Storage Temperature	-40°C to 85°C
Operational Characteristics:	
Air Interface and Adaptive Noise Features	The Transceiver technology employed should have the capability to optimize read rates for the vehicle identification application and adapt to instantaneous noise and interference level.

Application capability	1. Should have read reliability exceeding 99.5% in the distance range specified. 2. Diagnostic and reporting tools.
Upgradeability	The firmware should be upgradable to support future protocols.
Transaction capability	Reading of Tag and EPC memory for at least 2 tags per second for a moving vehicle with a speed limit of 40 km/h.
Driver Software	The Transceiver driver software shall be provided along with the Transceiver that will interface to the ETC client through socket interface and handle the communication with ETC client. The packet structure shall be as notified in the ETC client-transceiver interface. The driver software shall implement filtering using a range of EPC-codes/ Tag-TID code provided by set of bit pattern masks.

6. **Toll Lane Controller (TLC)**

- 6.1 Toll Lane Controller (TLC) will be used to control and monitor all the subsystems and peripheral equipment and communication of the lane for user fee collection process and vehicle passage. The TLC is located in the booth or the tunnel.
- 6.2 The TLC shall be required to transmit all transactions, incidents as well as other control information to the Toll Management System (TMS) in real time. All lanes shall be connected to the TMS server. The Lane Status Display Unit (LSDU) shall monitor activities of each lane in real time.
- 6.3 All lane operating data is required to be stored in the local hard disk drive in the lane. Adequate RAM shall be provided to prevent “Thrashing” of the hard disk drive. The hard disk needs to have enough memory to load and maintain all necessary program tables (like ETC blacklist, discount list, exempt list, etc.) and data in memory, to optimize the toll collection functionality. Each transaction data collected from the lane peripherals is to be stored in the local hard disk of the TLC in a separate encrypted file placed in a folder automatically created with the month’s name at the start of each month, before being transmitted to the master database in the local ETC server. The data shall remain in the local hard disk irrespective of transmission to the local ETC server for a period of 1 month.
- 6.4 Further, a mechanism is to be provided for auditing the real time data transmission (including incidents) over a predetermined time period (say 30 minutes) and automatic data retrieval from the lane in case of data mismatch.
 - i. The TLC must be capable of storing the following minimum information:
 - a. One month of Transaction data including image associated with incidents.
 - b. Tag Blacklist as mentioned.

- c. Tariff Table (active and pending)

Transaction record shall contain all the necessary information to enable complete control and auditing of the system.

- ii. The minimum required fields are as follows:
 - a. Transaction Sequence Number
 - b. Date
 - c. Time
 - d. Plaza
 - e. Lane
 - f. Shift
 - g. Tag Vehicle Class (TVC)
 - h. Automatic Vehicle Class (AVC)
 - i. Image ID (in case of a violation transaction)
 - j. Tag ID
 - k. VRN (Vehicle Registration No.)
 - l. Transaction Amount

The transaction time shall be the time when a Tag is detected at transaction area.

- iii. The TLC shall be capable of interfacing with at least the following peripheral equipment:
 - a. Toll Collector Display
 - b. UFD
 - c. Traffic Lights
 - d. OHLS
 - e. ABB
 - f. Exit Barrier Loop
 - g. AVCC system including AVCC loop
 - h. ETC equipment
 - i. Incident Recording (CCTV) System
 - j. LPICC
 - k. Thermal Receipt Printer
 - l. BCR

- 6.5 The TLC shall be capable of communicating with the local ETC server. Communication shall consist of data necessary to build a complete database in the local ETC server, from which the required financial and operating reports and statistics can be generated. The local ETC server shall also receive and log any reportable incidents occurring in the lane,

which shall be transmitted real-time to the Incidents Computer (IC) for action by the toll supervision staff. In terms of incidents, real-time shall mean the time from the occurrence of the incident to the storage of the incident and subsequent display of the incident on the IC; it shall not be greater than 2 seconds.

- 6.6 As described above, all data entries are to be sequentially numbered and referenced to other related entities. The incidents that occur during a transaction shall refer to that transaction. Transactions and incidents shall refer to the applicable financial entity in which they occur.
- 6.7 An automatic / manual data validation process is required to check for data continuity and missing/duplicate data. An audit trail of manual corrections is required. The data validation process shall be linked to a “data not complete” message that will be indicated on reports if data is missing / pending validation / consolidation.
- 6.8 The TLC (via the AVCC) shall monitor the lane at all times for any traffic violation or incident and for failure of any of the toll equipment. The level of incident reported to plaza via the peripherals in the toll lane or reported to the local ETC server shall be a parameter setting in the software available at a definable level.
- 6.9 The TLC shall also be capable of receiving messages from the local ETC Server. These messages will contain data on the Tariff tables, classification table, tag blacklists, ETC account balance, etc. Should the link between the TLC and the local ETC server fail, a system to download such information locally into either end (TLC & local ETC sever) is to be made available.
- 6.10 Time throughout the entire toll collection system shall be synchronized with reference to the local ETC server.
- 6.11 TLC shall be mounted inside an electronic enclosure. All electronic interface related peripherals/ controllers are to be enclosed in an IP65 compliant cabinet. Locking mechanism with a unique key providing access to the equipment inside has to be provided to the enclosure. Equipment is to be kept at temperature consistent with manufacturer’s recommendations.
- 6.12 **Lane Computer (Industrialized PC).**
- 6.12.1 Lane computer shall be mounted inside the electronic enclosure. Lane computer shall acquire all data from the lane peripherals and transmit them to the TMS in real time. The specification of lane computer shall be upgraded as per the latest specifications/ technologies available. A basic specification is provided in the table below:

Description	Specification
Type	Industrial grade cabinet computer.
Motherboard	Industrial grade.

HDD	Based on estimated storage requirements for 6 months data.
RAM	4 GB or latest as per requirement.
Processor	Intel i3 or equivalent/ higher.
Processor Speed	2 GHz or latest as per market
NIC	1 Gbps x 2 Nos on board.
PCI slot	2 Nos. spare
USB port (for authorized)	4 Nos.
Frame grabber cards (if used for capturing images)	1 with 2 channels capable of capturing frames at the same time on both channels

7. Automatic Vehicle Counter & Classifier (AVCC)

The AVCC system should be able to count and distinguish between predefined classes of vehicle. This information shall be transmitted to the Lane Computer and simultaneously to the LSDU (Lane Status Display Unit) data system on completion of AVCC classification. The Lane computer will match this information with the classification entered by the Toll collector (TC). If there is a discrepancy between the 2 classifications, the Incident Capture Camera shall be triggered to capture the digital image of the vehicle.

The AVCC shall have the following accuracy for the standard vehicles:

- i. For vehicle counting: 99.5%
- ii. For vehicle classification: 98%

7.1 Description and Functions

- i. The automatic vehicle classification equipment shall be installed in the lane after pay-axis.
- ii. The purpose of the AVCC is to sense the presence of a vehicle (differentiate it from non- vehicular crossing), to measure and interpret certain physical characteristics of the vehicle as it passes through the AVCC.
- iii. The AVCC shall be able to generate profile image which shall be used for auditing purpose.
- iv. The AVCC shall be able to distinguish between classes as per the applicable notifications of MORTH.
- v. This class information shall be stored locally at AVCC level and communicated to the TLC. Simultaneously, a still image of the vehicle shall be captured / grabbed by the ICS camera as the vehicle triggers the AVCC sensors. The TLC shall then check whether this AVCC class matches the vehicle class (the CCH Class mapped to the Toll Plaza class) as read from the tag. If there is a discrepancy between the two

classifications, the license plate image and the ICS camera image shall be saved and stored with all transaction and incident information watermarked on them. The images and discrepancy information shall be communicated to the Local ETC server for further action and processing by the toll supervision staff.

- vi. All AVCC elements shall be fully weatherproof and installed in a location where vehicle damage by accident is not possible.
- vii. When the TLC is inoperative, or communication between the TLC and the AVCC is severed, the AVCC shall record the last transaction number transmitted and shall be able to independently count and record (store) vehicle classes passing through or over it. A sequential vehicle counter at AVCC level shall be implemented to reconcile. The AVCC shall have its own battery backup and data extraction facility on to a pen drive or to a laptop computer.
- viii. The AVCC shall be able to generate violation if the ETC lane is not logged-in and a vehicle passes through it.
- ix. In following cases, the AVCC shall generate an alarm on the plaza level and send record to incident control system for supervisory action apart from the incidents defined:
 - a. Degraded classification (in case of any single Transmit / Receive failure).
 - b. Unable to classify.
- x. The accuracy of the AVCC shall not be affected by temperature or any weather /environmental conditions and shall be independent of vehicle speed / weight.

7.2 AVCC System Design

Functional requirements:

- i. The AVCC shall be able to automatically classify the classes of vehicles as indicated in the vehicle class table to an accuracy of 99.60% without manual intervention and class correction or validation. Unless, the above criteria is achieved, the AVCC shall never classify a vehicle to any defined category in the Classification table; it shall be categorized as unable to classify so that it triggers an incident and there is no chance for revenue loss. This can be used to fine tune the AVCC to improve the accuracy later.
- ii. The functional specification for the AVCC shall include the hardware, software and operational requirements. The design requirements of the AVCC are to be seen as a system in which all failures, events and other events are logged, stored and managed. The following design criteria shall be used in the AVCC:
 - a. AVCC Classification Table.
 - b. AVCC Configuration.
 - c. Vehicle Detection and Classification.
 - d. AVCC Interfaces.

- e. AVCC Technical Requirements.
- f. Data Storage.
- iii. All operating data shall be stored on the local hard disk drive of the AVCC computer. “Thrashing” of the hard disk drive shall be prevented. The AVCC shall have enough memory to load and maintain all necessary program tables and data in memory. All other transaction data shall be stored on the local hard drive of the AVCC and a copy to be transmitted to the local ETC server.
- iv. The following minimum information is to be stored at AVCC level:
 - a. Classification table.
 - b. AVCC configuration.
 - c. Data of at least one year (transaction, event, AVCC centric incident etc.).
- v. Two separate streams of data, carrying vehicle classification information from TLC and AVCC shall be copied at local ETC server level for comparison, evaluation and audit purposes. There shall be provisions for drawing separate reports for TLC and AVCC classifications at local ETC server level. An AVCC accuracy and reconciliation report shall be present in the toll system.
- vi. The performance of the AVCC will form the basis for the accuracy checks, functional tests, installation, commissioning and handover to achieve the required accuracy and performance.
- vii. The system architecture to provide the details of the equipment layouts and the physical location of each component of the system in the ETC toll lane.
- viii. The loop detector units/cards to conform to the following minimum requirements:
 - a. The unit shall be easily removable and shall be fitted with at least two (2) loops per card.
 - b. The unit shall have a minimum of 4 separate adjustable sensitivity and frequency levels.
 - c. The unit shall have indicators for vehicle presence, loop on/off and failure.
- ix. The AVCC Profiler to comply with the following specification and should be mounted in a manner as to ensure that the following minimum specifications are adhered to at all times:
 - a. Ensure that no vehicle can pass through the AVCC and miss axle counting.
 - b. Number of Axles per vehicle is accurately counted for every vehicle passage
 - c. Ensure to generate profile image of each vehicle.
 - d. Sensor replacement time shall not exceed 30 minutes.
- x. It shall be noted that the equipment enclosures shall be mounted in the tunnel/booth at the toll plaza, sufficient ventilation shall be provided by the equipment Service

Provider for this enclosure and the enclosure shall have IP65 protection.

- xi. The AVCC enclosure shall be mounted in the tunnel/booth. The AVCC enclosure shall be secured using suitable corrosion resistant fixtures, and all fixtures shall be approved before the mounting of the AVCC can take place.
- xii. The quality control procedure manual shall be provided with the proposal by the equipment Contractor, which shall include a minimum of:
 - a. AVCC Installation Log Sheet
 - b. Loop Resistance Testing and Loop Earth Testing Procedure
 - c. Cross-talk Verification Process
 - d. Loop Chatter (Bobbing) Verification Process
 - e. Basis of classification logic of AVCC

7.3 Independent AVCC computer

Specifications will be same as Lane Computer.

8. User Fare Display Unit

- 8.1 The User Fare Display_(UFD) shall be a LED display panel controlled automatically by the lane computer. It shall indicate to the road user the category of the vehicle and the amount payable/ balance in prepaid amount, low balance warning, public relations and seasonal messages.
- 8.2 The USB shall be of variable message type and shall have high intensity LED or similar operator approved display of 12 characters per line in two lines with the option of scrolling for displaying seasonal messages.

8.3 Specifications.

Description	Specifications
Size	750 mm x 400 mm
Display	Red LED Languages: English, Hindi and Local Language.
Visibility range	10 meters
Enclosure	MS
MTBF	50,000 hours
MTTR	less than 30 minutes
Protection	IP 65

9. **Automatic Boom Barrier (ABB)**

- 9.1 The function of ABB is to control the passage of vehicles through the Lane. Each Lane shall be fitted with an ABB. The operation of barrier is linked to the Lane controller. It allows the vehicle to pass through after a successful transaction has happened at the Lane.
- 9.2 The system consists of a fixed housing and a movable arm with a high impact breakaway device or provision. The housing shall contain the motor and control units along with the integrated metal detectors for the vehicle detection purpose. The housing shall be installed on the right side of the traffic direction, after the booth on a concrete base.
- 9.3 Swing away flange to prevent damages to the barrier/ vehicle in case of an unpermitted or forced drive-through. Boom contact shall be available which gives continuous alert to the TMS when the boom is missing or song away.

9.4 **Specifications.**

The automatic boom barrier shall meet the following technical specifications:

- i. The lane exit barrier shall be suitable for high speed ETC transactions. One full open-close cycle shall not take more than 1.2 seconds. The barriers used shall be capable of full lane open from a closed state in less than 0.6 seconds.
- ii. The housing and any mounting frame shall be fabricated from corrosion resistant materials. The barrier shall be driven electrically. The motor should not suffer damage when the barrier is blocked in any position.
- iii. Exit barriers shall have presence detectors independent to the AVCC system to prevent barrier arm from coming down on vehicles while passing. This shall be in the form of infrared units and dedicated embedded loops. Apart from the barrier arm, the mechanism may not have any moving protrusions that pose a risk to persons standing in close proximity to the barrier.
- iv. The barrier arm shall be fabricated from a light corrosion resistant material readily and inexpensively available in India. The barrier arm should have a protective mechanism whereby control fracture of the barrier arm occurs without damage to the housing of motor in the event of frontal collision. Preference will be given to non-destructive breakaway mechanisms.
- v. Further, there shall be protection mechanism to detect the presence of vehicles to avoid accidental hitting on the vehicles, whenever the boom is triggered for closing.
- vi. Suitable power supply scheme shall be implemented to feed the exit barrier and protect the source from being damaged due to electrical surges/ spikes injected by the dynamic (inductive) load. Further, the drive shall be so designed as that the damping factor is just sufficient for the drive to operate the booms without any jerks during open/ close to avoid freak hitting by the exiting vehicles.

vii. Barrier arms shall have retro-reflective red stripes in accordance with the local traffic signs standards.

viii. Automatic boom barrier shall be IP 55 rated.

ix. The following minimum specifications shall be met:

Boom length: 3.5 m

Boom material: Aluminium

10. **Over Head Lane Status Signs (OHLS)**

10.1 The OHLS is located above the centre of the lane at the lane entrance. The purpose of the OHLS is to indicate to the user whether the toll lane is open for the processing of vehicle or closed. A RED CROSS is used to signal that the lane is closed, while a GREEN ARROW is used to indicate that lane is open to traffic.

10.2 Signs must be sufficiently bright and directed to indicate to a motorist, approaching the toll Plaza, at a distance of 300 metre on a bright cloud free day that the Lane is available for use. The OHLS status shall also be visible up to a peripheral view of 45 degrees from the travel axis.

10.3 At any situation, both RED and GREEN part shall not glow simultaneously. Under failure conditions, only RED Cross shall be displayed until rectification.

10.4 **Specifications.**

Description	Specifications
Size	300mm x 300mm
Display (Cross)	Red LED
Display (Arrow)	Green LED
LED	5mm in diameter, 8000 mcd
Visibility Range	300m (150m under extreme weather conditions).
Enclosure	IP65 rated or better grade

11. **Traffic Lights with Mounting Pole**

11.1 The traffic light (TL) shall be located in the toll lanes in a position where it is readily visible to users of the toll road, usually on the side of the lane beyond the tollbooth. The traffic light shall consist of 2 traffic light heads mounted on a suitable pole. An AMBER

signal with arrow is used to indicate that the user should take suggested path, while the GREEN signal is used to indicate that the user should proceed.

- 11.2 At any situation, both AMBER and GREEN part shall not glow simultaneously. Under failure conditions, only amber arrow shall be displayed until rectification.

11.3 **Specifications.**

The following minimum specifications shall be met:

Description	Specifications
Size	200 mm
Display (Stop)	Amber LED
Display (Start)	Green LED
Visibility range	20 metres (normal visibility conditions)
Enclosure	SS
Protection	IP65 rated

12. **Loops with Detector**

Magnetic loops shall be used for two purposes:

- 12.1 **Presence Loop** - This is a single loop installed in the transaction area this shall be triggered on the basis of vehicle detection leading to a certain set of activities as required like AVCC operation.

- 12.2 **Exit Loop** - This is a single loop installed at the end of transaction used to trigger the exit barrier once the transaction has been completed.

- 12.3 **Specifications.** Loop detector units/ cards shall conform to the following minimum requirements:

- i. The unit shall be easily removable and shall be fitted with at least 2 loops per card.
- ii. The unit shall have a minimum of 4 separate adjustable sensitivity and frequency levels.
- iii. The unit shall have indicators for vehicle presence, loop on/ off and failure.

13. **Incident Capture Camera with mounting poles**

- 13.1 The incident capture camera is installed at a convenient location on the island to capture images and video clips of the vehicles for the following incidents:

- i. Class discrepancy between the classes detected by the AVCC and that entered by the toll collector.
- ii. Exempt users.
- iii. All transaction of vehicle with special events.
- iv. Offending vehicles.
- v. When the panic alarm footswitch is activated by the toll collector.

13.2 The camera shall be installed inside the housing at the suitable height above the surface of the lane (to be decided by the System Integrator) on a pole to record the vehicle images/ snapshots and video clip for every transaction in the lane. The vehicle images captured shall be of the front and right side portion of the vehicle. General requirements of the incident capture camera are as follows:

- i. The housing will be equipped with the hood to protect the camera under the direct sun light.
- ii. Protection : IP 65.
- iii. The stand of the lane camera shall be made of steel that shall not swing or twist under gutter speed of strong wind. The stand will be protected from corrosive environmental conditions.
- iv. The model selected shall have image compensation capability to ignore stray lighting/ vehicle lighting so that ICS and LPIC shall render meaningful output for verification.
- v. Each camera shall view and detect vehicle images for its lane. The cameras should be located so that sidelong profile of the vehicle is obtained as it crosses the AVC, so that number of axles of vehicle crossing the AVC shall be clearly visible when the vehicle is exiting the lane. The camera should have an automatic adjustment of brightness.

13.3 Specifications.

Description	Specifications
Image sensor	1/ 3" progressive scan CMOS
Minimum illumination	0.01Lux @ (F 1.2, AGC ON), 0 lux with IR
Shutter time	1/25s ~ 1/100,000s
Lens	2.8 - 12mm @ F1.4, Angle of View: 80° - 28.7°
Lens Mount	Ø 14

Day & Night	IR cut filter with auto switch
Wide Dynamic Range	Digital WDR
Digital Noise Reduction	3D DNR
Video compression	H.264 / M-JPEG
Bit rate	32 Kbps ~ 16 Mbps
Audio compression	-S:G.711/G.726/ MP2L2
Dual stream	Yes
Max. image resolution	1280 x 960
Frame rate	50 Hz : 25 fps (1280 x 960), 25fps (1280 x 720), 25 fps (704 x 576), 25 fps (640 x 480), 60 Hz: 30 fps (1280 x 960), 30 fps (1280 x 720), 30 fps (704 x 576), 30 fps (640 x 480)
Image setting	Saturation, brightness, contrast adjustable through client software or web browser
BLC	Yes, zone configurable
ROI	Yes, up to 4 configurable areas
Network storage	Shall store data on NVR
Alarm trigger	Motion detection, dynamic analysis, tampering alarm, network disconnect, IP address conflict, storage exception
Protocols	TCP/IP, ICMP, HTTP, HTTPS, FTP, DHCP, DNS, DDNS, RTP, RTCP, PPPoE, NTP, UPnP, SMTP, SNMP, IGMP, 802.1X, QoS
Security	User authentication, watermark, IP address filtering, anonymous access
System compatibility	ONVIF, PSIA, CGI, ISAPI
Communication interface	RJ 45 10 M / 100 M Ethernet interface
On-board storage	Built in Micro SD /SDHC/SDXC card slot, up to 64 GB
Reset button	Yes
Operating conditions	-30°C ~ 60°C (22°F ~ 140°F)

Power supply	12 VDC \pm 10%, PoE (802.3af)
Weatherproof	IP 66
Power consumption	Max 5.5 Watts (Max 7.5 Watts with IR cut filter on)
IR range	Up to 30 metres

14. **License Plate Image Capture Camera (LPICC).**

14.1 The camera shall be installed inside the housing at a suitable height above the surface of the lane, to be decided by the system integrator, on a pole to allow the automatic number plate capturing of the vehicle in the lane.

14.2 The system should automatically detect a vehicle in the camera view using video detection and activate license plate capture. The system shall automatically detect the license plate in the captured video feed in real time. It is expected that the software should provide at least 80% detection accuracy in daytime and 70% during night time with proper IR Illuminator.

14.3 The system shall store JPEG image of vehicle license plate. LPIC system shall achieve:

- i. Recording schedules can be continuous, event based, schedule based, trigger based, etc.
- ii. Virtual matrix - to allow viewing of live video in different layouts on operator screen.
- iii. Seamless working off fully integrated software platform.
- iv. Archive search using dates, time, event, etc.

14.4 **Specifications**

Description	Specifications
Image sensor	1/ 2.8" progressive scan CMOS
Signal System	PAL/NTSC
Minimum illumination	0.05 Lux @ (F 1.2, AGC ON), 0 lux with IR
Shutter time	1/25 (1/30)s to 1/100,000s
Lens	E13: 6 mm @ F 2.0 Angle of view: 45.3° (4 mm optional) E15: 12mm @ F 2.0 angle of view: 22°

Lens Mount	M 12
Day & Night	Date night visibility with colour images/ videos
Video compression	H.264 / M-JPEG/ MPEG4
Bit rate	32 Kbps ~ 16 Mbps
Dual stream	Yes
Max. image resolution	1920 x 1080
Frame rate	50 Hz : 25 fps (1920 x 1080), 60 Hz: 30 fps (1920 x 1080)
Image setting	Saturation, brightness, contrast adjustable through client software or web browser
Alarm trigger	Motion detection, dynamic analysis, tampering alarm
Security	User authentication, watermark, IP address filtering, anonymous access
System compatibility	ONVIF, PSIA, CGI
Operating conditions	-10°C ~ 60°C (14°F ~ 140°F)
Power supply	DC, PoE (802.3af)
Weatherproof	IP 66
OCR	Yes
Note	This camera needs external high power IR panel to illuminate license plate with a stronger IR light

15. Toll Collector Terminal (TCT)

The TCT shall consist of following equipment:

- i. Toll Collector Display - TFT Monitor.
- ii. Customized Industrial Grade Keyboard.
- iii. Receipt/ Ticket Printer (RPR).
- iv. Barcode Reader (BCR).

The TCT shall be the interface between the system and the toll collector. With the TCT, the collector shall be able to input the data in the system and the fee collected display and receipt printer shall provide the output data from the TLC to the collector.

15.1 Toll Collector Display - TFT Monitor.

The TCD shall be located on the toll collector's desktop and shall be screwed or bolted through the counter top. Suitable mounting brackets manufactured of stainless steel shall be provided to fix the screen to the desktop. All nuts and bolts that are used to secure the TCT to the booth counter top shall be stainless steel. It shall be system's interface to the toll collector to display the status of transactions and status of the lane peripherals.

15.1.1 Specifications.

The minimum technical specifications are as follows:

Description	Specifications
Display Type	TFT with diagonal size of 18.5" minimum
Cables	Power cable 1 x VGA cable (15 pin HDD- sub)
Cable routes	Power cable (15meters) is terminated to the TLC power distribution block via booth ducting. VGA cable (15meters) is terminated to the SVGA port at the LC via booth ducting.
Colour	Manufacturers original colour
Voltage	AC 230V (50/60 Hz)
Power consumption	80W
Operating Temperature	0°C to 50°C
Relative Humidity	20% to 80%
Design criteria	Minimum Resolution: 1024 x 768 x 60Hz Aspect Ratio. 4:3 Number of Colours : 16.2M (6 bit +FRC) Video Bandwidth: 70 MHz Viewable size: 18.5" minimum MTBF: 30,000 hours MTTR: 0.25 hours

15.2 Customized Industrial Grade Keyboard.

The keyboard on the toll collector terminal for registration of toll operations shall be a programmable industrial grade keyboard. The keyboard shall be used to enter data such as:

- i. Staff ID number.
- ii. Classification of vehicle.

- iii. Type of transaction.
- iv. Accept/ Cancel transaction.
- v. Selecting method of payment.
- vi. Numeric keypad with back space button for corrections.
- vii. Class Cancel.
- viii. Operating OHLS.
- ix. Bleed-off button.
- x. Violation cancel/ accept button.
- xi. Simulation button (only to be used during maintenance mode).
- xii. Alphanumeric keys in QWERTY format.

15.2.1 **Specifications:**

The minimum specifications of Customized Industrial Grade Keyboard shall be as follows:

- i. Shall have good programming capability.
- ii. Programming under DOS and windows, multiple page, multiple level, whole range key content, time delay, position sense answer back code, etc.
- iii. True spill resistant design.
- iv. Optional blank key, double key for alternative key group layout.
- v. Optional magnetic stripe reader.
- vi. 70 programming keys + 6 position control keys.
- vii. Key top size: 80 mm x 22 mm for single key.
- viii. Interface: PS/2 or USB.
- ix. Key switch life: 25 million operations.
- x. Dimensions: 340 mm (W) x 150 mm (D) x 58 mm (H); Weight: up to 1.2 kg.
- xi. Color: OEM specific.

15.3 Receipt/ Ticket Printer (RPR)

15.3.1 Thermal receipt / ticket printer (RPR) shall be used to print receipts in the lanes. The printers to be provided with automatic advance function of the paper after printing so that the space for the first line of printing is aligned under the print head reducing the time taken to produce a receipt.

15.3.2 For design purpose it shall be assume that receipts will be approximately 70 mm in length. The Authority and Project / Plaza information will occupy space on the top. The area under this shall be used for particular printed data. Shall take the approval from the Authority for the format of the receipt.

15.3.3 Specifications.

The minimum technical specifications for the ticket printer shall be as follows:

Description	Specifications
Dimension	Maximum upto 145 mm (W) x 195 mm (D) x 148 (H)
Weight	Shall be less than 2 kg.
Installation and fixing details	Installed and fixed on the Fee Controller desk
Cables	Power cable Serial RS232C/ parallel/ USB
Cable routes	Power cable is terminated to the TLC termination block via booth ducting. Data cable is connected to the TLC.
Colour	Cool white / dark grey
Power supply requirement	24 VDC \pm 7%
Access for maintenance, modularity of construction	The cover can be opened for maintenance. It also has paper sensors. Off -the-shelf product.
Operating temperature	5°C to 55°C
Relative Humidity	5% to 90%
Design criteria	i). Printing technology : thermal line printing ii). Print resolution: 180 dpi iii). Print speed : Max. 350mm/sec (13.8"/s), 1 graphics and text. iv). Print font: 9x17/ 12x24 v). Print column capacity: 56/ 42 columns vi). Character size (mm):0.99(W)x2.4(H) /1.41(W)x 3.4 (H) vii).Paper dimension (mm): 79.5 \pm .5 (W) x 83 (Diameter) viii).Paper thickness: 0.06 - 0.07 mm ix). Auto cutter life : 1.5 million cuts

	x). Real time printer status: Auto Status Back (ASB) Messages xi) MCBF: 52 million lines xii) MTBF: 3 60,000 hours, Overall MTTR: 0.25 hours xiii). Barcode: UPC-A/E, Code 39/93/128, CDABAR PDF417. QR-Code, MaxiCode, Data Matrix, Aztec Code, Composite Symbology, GS1-128, GS1 Databar Omnidirectional/ truncated/limited/expanded
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15.4 **Barcode Reader (BCR) with Stand**

Desktop mounted fixed barcode reader (BCR) shall be installed in the tollbooth on the toll collector's desktop. The road user upon reaching the pay-axis of the lane will produce the return oblique daily pass ticket. The toll collector will place the ticket on the barcode reader which will read the 2D barcode printed on the ticket. The lane controller shall get the transit details from the barcode which validates the ticket and authenticates the vehicle class (as entered by the toll collector) and the distance travelled for processing of the transaction.

15.4.1 **Specifications.**

The minimum BCR features and specifications shall be as follows:

- i. Scan Pattern: Single Line.
- ii. Motion Tolerance: 20°/sec.
- iii. Scan Rate: Upto 270 scans/ sec.
- iv. Print Contrast: 20% minimum reflectance difference.
- v. Pitch, Skew: 65°, 65°
- vi. Decode Capabilities: Reads Standard 1D and GS1 databar symbologies.
- vii. Light levels: 0-70,000 Lux (direct sunlight).
- viii. Dimensions : 152mm (H) x 152mm (W) x 91mm (D) ; Weight : not more than 500 grams.
- ix. Interface: USB or serial.

16. **Violation light, Alarm and Footswitch.**

The emergency footswitch is located in each booth under the toll collector's desk. The footswitch is provided for use in case of emergency or an accident . Pressing the footswitch shall raise an alarm to the auditor via the LSDU and activate a siren.

Revolving light and the siren are fitted on the top of the booth.

16.1 **Specifications.**

The minimum specifications for the emergency footswitch are as follows:

Description	Specifications
Installation and fixing details	Mounted on the floor inside the toll booth under the desktop
Cables	Power cable Signal cable
Cable routes	- The power cable is laid inside the booth manhole before terminating to the TLC termination block. - Data cable is connected to the TLC DI board from the termination block
Colour	Manufacturer's original colour
Material & Finishes	Steel / Aluminium
Power supply requirement	220-240 V AC, 50-60 Hz, 10A
Access for maintenance, modularity of construction	Modular design only plug and replace when fails
Operating temperature	0°C to 50°C
Reliability and maintainability	MCBF: 100,000 operations MTTR: 0.5 hours
Siren Specifications: (Minimum specifications for the siren)	
Technology	Motor driven or better
Audible rating	112 dB at 1:00 metre
Environmental	Designed to meet IP 54

17. Tollbooth CCTV cameras

- 17.1 The booth CCTV camera shall be Fixed Dome type IP in (Internet Protocol) camera installed inside the booth to capture the activities of the Toll Collector while performing his operations. The camera shall also capture the view of the paying vehicle.
- 17.2 These cameras shall be connected to the Plaza video server installed at the TMS server room at each Plaza building. The camera shall be capable of triggering alarms in case of camera tampering detection and audio detection. The triggering alerts can be controlled by the control room operator.

17.3 Specifications.

Description	Specifications
Image sensor	1 / 2.8" Progressive CMOS
Maximum resolution	1980 x 1080 (2MP)
Lens type	Fixed focal
Focal length	f= 2.8mm
Aperture	F1.8
Field of View	110° horizontal 64° vertical 135° diagonal
Shutter Time	1/5 sec to 1/30,000 sec.
Day/ night	Removable IR-cut filter for day & night functions.
Minimum Illumination	0.08 Lux @ F 1.8 (colour) 0.001 Lux @ F 1.8 (B/W)
IR illuminator	Built in IR illuminators, effective up to 25 metres or better IR LIED *8
Onboard storage	SD/ SDHC/ SDXC card slot
Compression	H.264 & MJPEG
Maximum frame rate	30fps @1920 x 1080 In both compression modes
Maximum streams	4 simultaneous streams
S/N ratio	Above 55dB
Dynamic range	97 dB or better
Video streaming	Adjustable resolution, quality and bit rate
Image settings	Adjustable image size, quality and bit rate, timestamp, text overlay, flip and mirror, configurable brightness, contrast, saturation, sharpness, white balance, exposure control, gain, backlight compensation, privacy masks, schedule profile settings, seamless recording, smart stream, 3D noise reduction, video rotation.

Compression	G .711, G .726
Interface	External microphone input Audio output
Protocols	IPv4, IPv6, TCP/IP, HTTP, HTTPS, UPnP, RTSP/ RTP/ RTCP, IGMP, SMTP, FTP, DHCP, NTP, DNS, DDNS, PPPoE, CoS, QoS, SNMP, 802.IX, UDP, ICMP
Interface	10Base-T/ 100Base TX, Ethernet RJ-45
ONVIF	Supported
Alarm Triggers	Video motion detection, manual trigger, digital input, periodical trigger, system boot, recording notification, camera tampering detection, audio detection.
Alarm events	Event notification using digital output, HTP, SMTP, FTP and NAS server, SD card. File upload via HTTP, SMTP, FTP, NAS server and SD card.
Connectors	RJ- 45 cable connector for network / PoE connection Audio output DC 12V power input Digital input *1 Digital output *1
LED indicator	System power and status indicator
Power inputs	Max. 9W (PoE)
Safety certification	CE, LVD, TCC Class B, VCCI, C-Tick
Operating temperature	Starting Temperature: -10°C to 50°C (14°F ~ 122°F)

18. **Cabling & Networking.**

18.1 Adequate perforated cable trays and/or cable support wherever required, for all cabling required in Toll Lanes / Booths & Plaza Office shall be provided.

18.2 **Cabling from Toll Plaza Lanes to Toll Office Building**

4 core armored OFC cable is to be used for system connectivity between the Exit/ Entry Plazas and the Toll Office Building. Two 28 mm (outer diameter) permanently lubricated HDPE telecom ducts/ conduit shall be installed underground to lay OFC cables.

18.3. **Cable Numbering**

All cables installed shall be numbered with ferules, in accordance with the universal

cable numbering system, in such a way that any person shall be able to understand & identify cabling for specific equipment.

18.4 **8-port PoE Industrial Grade rugged Switch with 2 Fiber Port (layer3)**

8-Port PoE industrial grade rugged managed switch with 2 fibre port shall be provided in each entry and exit plaza to ensure that the data transmission between the lanes and Toll Office Server is smooth and faster. This will also prevent data broadcasting from lanes which may result in choking of the entire network and slows the data transfer and efficiency of the lane equipment.

Specifications. 8-port PoE Industrial Grade rugged Switch shall have the following minimum specifications:

- i. Switch shall have minimum 8 Nos. 10/100 Base-T with minimum 6 PoE ports with power budget of 60W and additional 2 Nos. of SFP uplink ports loaded with MMF modules.
- ii. Shall be IP30 rated and shall work up to 60°C temperature in a sealed enclosure and should be DIN rail mountable.
- iii. Switch shall be IEC 60068-2-6, IEC 60068- 2- 27, IEC-2- 47, IEC 60068-2- 64, IEC 6100-4- 5 and NEMA TS-2 compliant.

18.5. **24 Port Switch with 4 Fibre Port (Layer 3)**

- i. Switch shall have minimum 24 Nos. 10/ 100/ 1000 Base-T ports and additional 4 Nos. SFP uplink ports loaded with MMF modules with dedicated stacking ports.
- ii. Switch shall have wire rate performance and 48 Gbps of dedicated stacking bandwidth.
- iii. Switch should support port security, DHCP snooping, Dynamic ARP inspection, IP Source guard, BPDU Guard, spanning tree root guard.
- iv. Switch should be IPv6 Certified/IPv6 logo ready and Switch / Switch's Operating System should be tested and certified or in process of certification for EAL 2/NDPP or above under Common Criteria Certification.
- v. Switch should have 1:1 redundant internal power supply. Power supply modules, fan modules and transceivers modules should be hot swappable.
- vi. Should support IEEE Standards of Ethernet: IEEE 802.1D, 802.1s, 802.1w, 802.1x, 802.3ad, 802.3x, 802.1p, 802.1Q, 802.3, 802.3u, 802.3ab, 802.3z, 802.3az.

19. **Wi-Fi Enabled RFID Handheld Reader**

Minimum Specifications	
Dimensions:	192mm x 87mm x 7.5 x 3.43 5.94in 151mm/ 6 x
Weight:	743g/ 26.21oz, or equivalent/latest
Display:	3.5'' QVGA (240*320), 6.5M colors or equivalent/latest
Touch Panel	Rugged resistive touch panel, or equivalent/latest
Power	Main battery: Li-ion, 3200mAh
	Pistol battery: Li-ion, 5200mAh
Expansion Slot	1 MicroSD (TF) slot
Interfaces	Micro USB(OTG)
Audio	0.5W speaker
Keypad	Numeric / Qwerty
User Environment	
Operating Temp.	-4oF to 122oF / -20oC to 50oC
Storage Temp.	-40oF to 158oF / -40oC to 70oC
Humidity	5%RH - 95%RH non-condensing
Drop Specification	Multiple 1.5m drops to concrete across the
	operating temperature range
Tumble Specification	1000 x 0.5m/1.64ft falls at room temperature
Sealing	Host IP65 per IEC sealing specifications
Communication	
WLAN	IEEE802.11 a/b/g/n
Bluetooth	Bluetooth 2.0+EDR
Engine	CM2000-1 module, on Impin Ind R2000, based j y or equivalent/latest
Frequency	865MHz-868MHz / 920-925MHz / 902-

	928MHz
Protocol	EPC C1 GEN2 / ISO18000-6C
Antenna	Linear polarization (1.8dBi); circular polarization (4 dBi) (Internal Antenna)
Power	1W (30dBm, +5dBm to +30dBm adjustable)
R/W range	>22m (circular polarization, indoors); >8m (circular polarization, open outdoors); >4.5m (linear polarization, open outdoors);
Reading rate	>200 tags/s (circular polarization)
* Range and rate depend on tags and environment	

19.1 Industrial Grade outdoor rugged Wi-Fi Access Point

The Wi-Fi Access point shall be provided as backup for the wired LAN network. The Wi-fi Access points shall be connected to the LAN network in the lane area. The minimum specifications of Industrial grade outdoor rugged Wi-Fi Access Point are as follows:

- i. Wall/Ceiling/Poll mounted Wi-fi access-point suitable for outdoor use with at least 1 10/100/1000Mbps Ethernet ports supporting standard 802.3af/at POE+.
- ii. 802.11ac AP should operate in 2.4 GHz (450 Mbps or more) and 5 GHz simultaneously and capable of minimum 860 Mbps on 5 Ghz for 802.11ac clients supporting minimum 2x2 MIMO with 2 spatial streams. It must support minimum 2 concurrent MU-MIMO users.
- iii. Security mechanisms should be in place to protect the communication between the Access Point controller and the Access Points.
- iv. The access point should support WPA2 enterprise authentication and AES/CCMP encryption.
- v. Implement Wi-Fi alliance standards WMM, 802.11d, 802.11h and 802.11e and should support VoWLAN
- vi. AP must support L7 Application Identification and spectrum analysis functions.
- vii. AP should support Minimum -90dB Receiving sensitivity. AP should support Receiver sensitivity Threshold to reduce noise reception in the AP to increase SNR and performance
- viii. 802.11 a/b/g/n/ac wave 2 functionality certified by the Wi-Fi alliance, should be IP67 rated and RF transmission power should be approved by WPC.
- ix. AP should support up to 160 kmph sustained winds and up to 265 kmph wind gust.

20. **Medium Speed Weigh in Motion (MSWIM)**

- i. The MSWIM should be able to capture number of axles, axle spacing, number of wheels and gross weight of vehicle and height of each passing vehicle and provide data of each vehicle to the lane controller for further auditing and analysis.
- ii. Gross weight of the vehicle approaching the toll booth shall be automatically detected for speed range prescribed in the specifications.
- iii. The detected weight shall not be displayed on the computer terminal of toll collector until the toll collector classifies the vehicle.
- iv. If the vehicle is found to be overloaded as per the Toll Collector Classification, the weight information shall be displayed as overweight warning.
- v. The excess fee charged against overload vehicles shall also be separately printed on user receipts of such vehicles.
- vi. MIS reports shall be available for the Authority on numbers of overloaded vehicles crossing any toll plaza as per a prescribed format.

Description	Specifications
Capacity of the Platform	30 ton/ Axle
Technology	Bending Plate Technology
Stationary Accuracy	±0.1% FSR
In Motion Accuracy	±7% FSR upto speed of 50 km/hr
Overload capacity of the platform	150% of the rated capacity.
Vehicle separator	IR based curtain housed in weather proof IP65 rated pillars with proper sealing.
Controller Housing	Water/ weather proof with anti-rust coating: IP65 rated.
Approval/ Certification	Weights and Measures Approved Model, duly stamped & sealed by W&M Dept on installation.
Re-calibration/ stamping & verification	Every 12 months
Downtime allowed for periodic maintenance	Maximum 24 hours per quarter

21. **Static Weigh Bridge (SWB).**

- 21.1 The Static Weigh Bridge (SWB) shall be installed in the entry toll plazas in a separate area having facility of parking of overloaded vehicles. This is to ensure that an overloaded vehicle does not ply on the Expressway.
- 21.2 The SWB system shall be able to capture toll transaction number with date and time, vehicle registration number, category of vehicle, permissible weight and gross vehicle weight along with date/ time of weighing and the receipt printed by SWB system shall contain the above information. This system shall also be integrated with the toll system and generate a closure report. A computer, printer, data/ OFC connectivity and UPS should be made available alongwith SWB.
- 21.3 The SWB station should have CCTV camera for capturing image of vehicle while weighing.
- 21.4 Monthly MIS reports shall be available for audit such as: Actual Overloaded Vehicles, Total Overweight Vehicles (MSWIM) vs Actual Overweight, etc.
- 21.5 **Specifications.**

Description	Specification
Type	Site specific (pit/ pitless/ mobile)
Body/ platform	Steel
Size	120 tons
Capacity	I-beam complying BIS 2062. Top plate - 10 mm or more - Steel as per BIS 2062
Structure	Duly certified for structural analysis and design ST AAD)-III
Number of load cells	8
Type of load cells	Compression Type/ Double ended shear beam Stainless steel 17-4 Ph
Protection class for the load cells	IP68 or better, Operational Temp: 10 to 65 degrees
Protection class for the weighing indicator	IP68 or better, Operational Temp: 10 to 65 degrees
Overload capacity	150% of rated capacity.
Accuracy class	OIML-C-IV
Accuracy tolerance	Upto 0.02%
Painting	Anti-rust and Anti-corrosion painting

BIS specification	IS-9281 (Part-III)
Compliant	Egal Metrology Act 2009 (1 of 2010) And rules framed thereunder from time to time, Duly sealed by the Weights and Measures Department.
Approval / certification	Weights & Measures approved model.

22. Workstations for MIS, Cashup, Audit & LSDU System (in Control Room)

The workstation will be used by the System Administrator and /or toll supervisor to access the system for admin / audit purpose. At least 4 workstations / laptops should be provided in the Plaza office/ control room.

Specifications:

Description	Specifications
Processor	Intel Core i5, processor 2.4 GHz, 8 MB cache , 1600 MHz, 4 core, hyper threading, Intel HD graphics
Memory (RAM)	4 GB or better
Storage	300 GB or better
Network	Integrated NIC
Ports	RJ-45, 1 USB 3.0, 3 USB 2.0
Monitor	18.5 inches LED.
Input interface	Keyboard and mouse
Antivirus	Yes

23. Network Laser Printer (Black & White).

At least 2 network printers shall be required in the Plaza office or control room with following minimum specifications :

- i. 25 PPM
- ii. Duplex.
- iii. Fast Ethernet and should support paper size: letter / legal / Executive / statement / 80.5 inches x 13 inches / envelope No. 10 / Monarch Envelope/ custom size.

24. Building CCTV Camera.

- i. The camera shall be connected to the NVR. The video management software installed on the NVR shall provide the facility to control the cameras at supervision control room at the Plaza buildings.

- ii. Cameras shall be for monitoring of security areas such as control room, cash room, server room and admin, etc.
- iii. These cameras shall be Fixed Lens Bullet CCTV night vision colour cameras. The bullet cameras installed outdoor shall be installed in the weatherproof enclosure.
- iv. **Specifications.**

Description	Specifications
Image sensor	1 / 2.8" Progressive CMOS
Maximum resolution	1980 x 1080 (2MP)
Lens type	Fixed focal
Focal length	f= 3.6mm
Aperture	F2.1
Field of View	83° horizontal 53° vertical 91° diagonal
Shutter Time	1/5 sec to 1/30,000 sec.
Day/ night	Removable IR-cut filter for day & night functions.
Minimum Illumination	0.086 Lux @ F2.1 (colour) 0.001 Lux @ 2.1 (B/W)
IR illuminator	Built in IR illuminators, effective upto 30 metres
Onboard storage	Slot Type: SD/ SDHC/ SDXC card slot Seamless Recording
Compression	H.265 & MJPEG
Maximum frame rate	30fps @ 1920 x 1080 In both compression modes
Maximum streams	4 simultaneous streams
S/N ratio	50dB or better
Dynamic range	95 dB or better
Video streaming	Adjustable resolution , quality and bit rate
Image settings	Adjustable image size, quality and bit rate, timestamp, text overlay, flip and mirror, configurable brightness,

	contrast, saturation, sharpness, white balance, exposure control, gain, backlight compensation, privacy masks, schedule profile settings, seamless recording, smart stream, 3D noise reduction, video rotation.
Audio capability	Two way audio - full duplex
Compression	G .711, G .726
Interface	External microphone input Audio output
Protocols	IPv4, IPv6, TCP/IP, HTTP, HTTPS, UPnP, RTSP/RTP/RTCP, IGMP, SMTP, FTP, DHCP, NTP, DNS, DDNS, PPPoE, CoS, QoS, SNMP, 802.IX, UDP, ICMP, ARP, SSL, TRS
Interface	10Base-T/100 Base TX, Ethernet RJ-45
ONVIF	Supported
Alarm Triggers	Video motion detection, manual trigger, digital input, periodical trigger, system boot, recording notification, camera tampering detection, audio detection.
Alarm events	Event notification using digital output, HTP, SMTP, FTP and NAS server, SD card. File upload via HTTP, SMTP, FTP, NAS server and SD card
Smart Focus System	Fixed Focus
Connectors	RJ- 45 cable connector for network / PoE connection Audio output DC 12V power input Digital input :1 Digital output :1
LED indicator	System power and status indicator
Casing	Weather Proof IP66 rated housing. Vandal Proof IK-10 rated metal housing (casing only)
Safety certification	CE, LVD, TCC Class B, VCCI, C-Tick
Operating temperature	-10°C to 50°C (14°F ~ 122°F)

25. **Network Video Recorder.** H.265 Linux based embedded standalone NVR shall be provided. Shall support 16-channel/ 24 channel/ 32-channel network cameras. The NVR shall be ONVIF compliant and scalable configuration with features to help users to setup and manage advanced IP surveillance systems with ease. The NVR shall also support remote and mobile access, via web based application and app for both iOS and Android devices.

25.1 The NVR shall have minimum following technical features:

- i. H.265 Compression Technology.
- ii. Plug and play one button auto setup.
- iii. Intuitive, intelligent and interactive UI.
- iv. Live viewing, recording and playback features.
- v. Embedded Linux OS or OEM specific.
- vi. Support RAID 0/1/5 storage.
- vii. Upto 12 MP camera live view & playback.
- viii. Dual LAN Network ports with failover function.
- ix. ONVIF Open Platform.

25.2 Display of CCTV Monitoring.

A 55” professional grade display with wide viewing angle, full HD resolution and shall be suitable for 24x7 indoor application. The monitor shall have high contrast issue, lightweight design full high definition 1920 x 1080 resolution and anti-glare panel. It shall have an inbuilt VGA, DVI, S-video and HDMI ports for multiple video inputs.

Specifications.

Description	Specifications
Panel size	55”
Light source	LED Backlight
Resolution	1920 x 1080 pixels
Dynamic contrast ratio	1400:1
Viewing angle	Horizontal: 178°, Vertical: 178°
Display feature	Full HD; Panel
Response time	Minimum 8ms
Lifetime	Minimum 50,000 hours
Colours	Minimum 16 million
Brightness	350cd/ m ²
Panel thickness	Not more than 65mm

26. Intercom System

26.1 Master Communication Unit.

The Master Communication Unit (MCU) is a master communication system to control communication between the toll collector at the lane and the auditor at the plaza building. The unit will be located in the control room and controlled by auditor oblique supervisor.

Specifications.

Description	Specifications
Power Source	24 volts DC
Current consumption	Maximum 1A, 80mA in standby
Communication	Push to talk to master station hands free at sub station
Calling	LED and intermittent ringing tone at master until answered
Frequency response	770-6800 Hz
Total harmonic distortion	3% @ 1000 Hertz at 20:00 ohms
Mounting	Wall or desk Mount
Wiring	2 conductor per substation
MTBF	30,000 hours

26.2 Intercom Slave Communication Unit (ISCU)

Intercom slave communication unit (ISCU) shall be used for communication between the toll collector at the lane and the auditor/ supervisor at the plaza office building. It should have the following functions:

- i. It shall provide hands free 2-way verbal communication between the supervision staff in the control room and the toll collector. The toll collector shall be able to attract the attention of the auditor in the control room by pressing a single button on the intercom slave unit.
- ii. The equipment shall also have the facility to allow the supervision staff to monitor communication in the booth between the toll collector and the user or between any 2 booths without alerting the toll collectors.
- iii. The voice communication system shall operate independent of the TLC system.
- iv. The voice communication shall also be implemented in various rooms of the Plaza office building and at building access points.

- v. 2-way communications shall be possible as soon as the auditor responds by selecting the appropriate Lane button on the master communication unit.
- vi. One way communication shall be possible from the control room intercom to all lanes simultaneously (broadcast).

vii. **Specifications**

Description	Specifications
Installation and fixing details	Fixed in the booth (wall/ desk Mount)
Speech method	Hands free
Wiring distance	120 metres with 0.202 mm diameter (33 AWG) cable 300 metres with 1.024 mm diameter (18 AWG) cable
Speaker	20 ohms
Power consumption	6 W maximum
Power supply requirement	Power supply from master system
Wiring	2 wires, non-twisted
Environmental considerations	Operating temperature of 10°C to 50°C
Reliability	30,000 hours

27. **UPS System.**

27.1 **Toll Office UPS.** Online UPS with 4 hours of backup and sizing based on power requirement calculations shall be provided for Toll office systems. The UPS design shall take the following into account:

- i. The system shall be capable of maintaining an uninterrupted power supply to the UPS loads for a sustained period of at least 4 hours under full load conditions from a fully charged battery.
- ii. It shall be capable of continuously supplying power to the system under an intermittent interruption cycle.
- iii. The ups shall be capable of operating at input voltages of 210/ 380 volts \pm 10% and 50 Hertz \pm 2.5 Hertz.

27.2 Lane Level UPS (2 KVA).

Lane level UPS shall be provided where central UPS supply is not made available to the lane systems. Specifications of lane level UPS shall be as follows:

Parameter	Minimum Specification
UPS with Battery	Online
Rating	As per power requirement (125% of connected load)
Backup	2 Hours
Input Voltage	155-305 VAC
Input Frequency	50H z
Output Voltage	230 VAC
Output Waveform	Sine Wave

28. Cabling.

28.1 All cables and wires shall be of good quality, confirming to normal accepted industry standards and shall be of proper type and have sufficient ratings for the particular application. All exposed ends of unconnected cables and wires shall be coated with watertight sealing compound or sealing tape to avoid damage to conductors. All communication cables used shall have a clearly marked label securely fixed near each and in accordance with the cable network diagram.

28.2 All cables and wires shall be adequately protected from the edges of equipment housing or other surrounding objects. All the cables and wires shall be neatly arranged and securely placed in such a way that all terminals are relieved of the weight of the cables. Terminals shall be coded and identified as per the wiring diagrams. Live metal shall be recessed or protected to avoid accidental contact.

29. ETC Server (Plaza Server)

29.1 The local ETC server is responsible for the control, data storage, processing and administration of the toll operation. It shall be the responsibility of toll management server to synchronize all activities of **CLOSED TOLL COLLECTION PROCESS**, data and time of all workstations.

29.2 There shall be a separate partition for Operating System. All Data files shall be stored in a separate partition. Image files shall have a separate 3rd partition. This scheme is applicable not only for the local ETC server but in all levels of Toll System.

29.3 Storage sizing at each level shall be backed up with corresponding file size per transaction/ record as part of technical specifications delivery.

29.4 General Requirements:

- i. The manufacturer of the server and workstations shall:
 - a. Be a well-known and established company worldwide in the field of Information Technology.
 - b. Have an established and appointed representative or authorized agency in project location.
- ii. The contractor of the server and workstations shall:
 - a. Be a well-known and established IT hardware supply company in project location.
 - b. Be a registered representative of the original equipment manufacturer in project location.
 - c. Be capable of supplying adequate after-sales service and support on 24x7 basis.
- iii Platform. The server shall make use of minimum 64-bit platform.
- iv. Configuration:
 - a. Processor board: shall have the capacity to accept up to 4, 64-bit central processor units.
 - b. Central Processor Unit/s: shall be 64-bit, Xenon 3 GHz or superior latest available speed at the time of delivery to the site.
 - c. Number of Processors: 2
 - d. RAM: 8 GB (Upgrade up to 16GB)
 - e. RAID (Redundant Array of Inexpensive Disks): shall use RAID5 with hardware RAID controller.
 - f. SCSI Controller: shall have a minimum of two channels.
 - g. HDD: Hot swap disks of latest available speed; capacity shall be based on data retention of all data for a period of 5 years.
 - h. DVD R/W: latest available speed.
 - i. Network Devices: 3X10G (Gigabit) LAN NIC (Network Interface Card).
 - j. Power Supply: Shall have a dual hot swap power supply to provide redundancy
 - k. Connectivity: Two (2) standard communications ports (D sub 9 pin), Four USB (Universal Serial Bus) ports (High Speed USB 2.0), SVGA Screen port.
 - l. Light path diagnostic with external visible panel.
 - m. LCD display for server operational log (events).
 - n. Integrated system management processor on board.

- o. Redundant hot swap fans.
 - p. Optical scroll Mouse.
 - q. 17" TFT monitor.
- v. The server including all accessories listed above shall be installed in 42U rack.
- vi. **Software Compatibility**

The server shall be capable of supporting the following software platforms:

 - a. **Operating System:**
 - Windows
 - UNIX
 - LINUX (64-bit platform) or compatible
 - b. **Database:**
 - Industry standard
- vii. **Backup Device.** Backup device shall be connected with the server through a SCSI controller card and shall be DLT drive 80/160 GB.
- viii. **Archive Storage Device**
 - a. This device shall be connected with the server through a USB port and shall be of a reputed make with service and support availability in India and of RAID configuration.
 - b. This device shall contain all the archived data on a monthly basis after the 5 year retention period. It shall be possible to restore a copy of the archived data for selected months to the live database as and when required and can be removed immediately after it serves its purpose. Since, this data is to be utilized only for reporting purposes, all the transaction and related data shall be retained in the archive.
 - c. However, the LPICC, ICS image grabs, AVCC profile against each transaction can be archived separately on DVD / Tape after the 5 year retention period and will not be stored in the Server Hard disk and USB based Archive storage device.
- ix. **System Image Storage Device**

A separate secure external HDD shall be supplied for storing the ghost images of all fresh installation of lane / AVCC controller and other modules, local ETC Server, etc. After restoring this ghost image, it shall be possible to import / configure the lane / equipment specific characteristics before normal operation of the equipment. Any data required shall be restored from the back-up device. In case of local ETC Server restoration, the current day data after backup to external storage device can be retrieved from the lanes.

- x. **System Software.** The system shall be in Domain environment and all workstations must connect to that domain.
- xi. **Licensing**

License for each server, workstation operating system, Database management system software, database maintenance software (like TOAD, etc.) or any other software (MS-OFFICE package, Adobe, GHOST etc.) used in toll system, which requires a license, shall be acquired and handed over on operationalizing of the system.
- xii. **Database Management System**
 - a. Database shall be a relational database management system.
 - b. Lane system shall not have any direct database access. Data from the lane going to the database shall be through dedicated software that runs on database server.
- xiii. **Data Network**
 - a. The data network shall be Ethernet format. The network shall use TCP/IP protocol and the cabling shall be STP / MM OFC and it shall be compatible with all network system and equipment.
 - b. Care shall be taken to ensure that the cable and the network switches used between two equipment shall be able to cater to the speed of the higher NIC.
- xiv. **Remote Access & Firewall**

Remote access shall be through a safety system as a remote connection server or firewall system. The toll system network shall be compliant with the majority remote access equipment and remote access system and it shall be configured with any remote system available at site.
- xv. **Hardware and Software Control System**
 - a. Hardware and Software fault logging system. This shall include all information regarding faults, downtime and repair time, imported from the ETC Server.
 - b. **Help Menu.** An intuitive and interactive help system that can be activated from anywhere in the TMS system.
- xvi. **Security System**
 - a. The plaza ETC system shall at its highest level determine access to the separate modules by any employee. It shall have the facility to define the employee according to an associated level or duty, and provide a mechanism, whereby access is restricted.
 - b. All FDD and CD R/RW of workstation shall be disabled and except Administrator no one shall have any right assigned to add, remove or modify any program on any of the workstations.

- c. Nothing other than toll collection and operations function shall be accessible to any level of toll operation function. If need arises, then the user shall logout, exit the application using administrator rights.
- d. After this Logoff from the system the user shall login into Windows with Administrator rights and perform any required action. This is applicable for all levels of the Toll System.

xvii. **Workstations Management**

At any time, if there is a to add additional workstations and its peripheral hardware from the system, shall be able to do so without any additional cost.

xviii. **Interfaces**

The system shall be designed using Open interface architecture at all levels of hardware used. In future, it shall be possible to change any make / model of any hardware without dependency on the Contractor/ System Integrator.

xix. **Data Management and Integrity**

The basic need for data integrity is the account closing at the administrative level. The closing process assumes that all data from the lanes has been introduced into the database.

- a. This can be resumed to:
 - Guarantee the data in database is complete.
 - Guarantee the data in database is correct.
- b. This is accomplished with:
 - Checksum: let detect errors in data.
 - Data type sequencing: let detect missing sequence.
 - Communication sequence: this is a periodic messaging to allow detection of communication failure.

Since, the whole Toll Collection system is designed to detect and subsequently prevent misuse in any manner and collect all collectible revenues, any transaction / operation performed in any level of the Plaza ETC system shall be recorded in the system on detecting a definitive positive / negative confirmation only. Usage of any other irrelevant keys under such conditions shall display a warning message to use the correct keys.

xx. **Data Sequence.** Each message / transaction shall have its own sequential number.

xxi. **Missing Data Detection and Resolution**

- a. The conditions to ensure that all data is in the database in a given moment is:
 - All message sequences received were correct (no checksum errors).

- There were no jumps in message sequential number.
 - There were no jumps in message type sequential number,
 - The Communication sequence is being received with no gaps and small permissible delays.
 - The message sequence type counters into Communication sequence are in accordance with the counters received in actual messages.
- b. The program used to insert lane messages into the database keeps making the above checks. If any problem is detected, it is signalled to plaza level.
- c. If any of the conditions above fail, the system signals a problem with the data on a connected workstation in graphical form i.e. for each lane by hour. The resolution of the problem is:
- If there is a data error (message received with bad checksum or bad data fields) the system automatically tries to read the TLC / AVCC message again.
 - If data is missing, the normal way to solve this will be to make an export from TLC and import in Administrative System using lane data import function. If the problem persists, the specific situation will have to be analysed by going in details like which kind of data sequence is missing revenue or non-revenue, the missing sequence details shall be made available just by clicking on the failure block of the lane data as represented by the lane data failure graphics.

xxii. **Data Import / Export System**

Reports Information to a Microsoft Excel, comma separated and MS Access compatible database file.

xxiii. **Data Backup & Restore System**

Data shall be backed up onto a removable medium on a regular basis for removal from the premises. A backup process and plan with the proposal shall be prepared and will be checked during system handover.

xxiv. **Data archiving / restore**

- a. Data archived on removable media on a regular basis shall be as specified under relevant clause.
- b. All data shall be transferred / appended to removable electronic media / USB based Archive Storage device at monthly intervals and stored after the expiration of the prescribed period for retention of the data on various system levels, the data may be removed from the system. The plaza ETC system shall provide the facility to perform these functions.

xxv. **Data Redundancy**

- a. All transaction and incident data shall be retained duplicated and stored within the various levels of the toll collection system such that should any

level or component of that level suffer a partial or total failure, the data is not irretrievably lost to the system. In addition, it shall be possible to reconstruct and restore the data for the failed level from the stored data into its original format.

- b. Data retention times within the various levels shall be at least:
 - Vehicle Processing at Lane Level: 1month
 - **Plaza level:**
 - o Detailed Data: 36 months
 - o Archived Data on USB Archive Storage: 10years

xxvi. **Data Transfer**

No workstation / controller can be used as a router to send data to the server database; all data shall be reported directly to the server.

29.5 **Incident Management Workstation**

- i. This module facilitates the supervisor to acknowledge incidents and to correct class discrepancies generated at lane level. Incident capture camera and License plate capture camera image/s and sensor outputs shall help supervisor in deciding the correct class of the vehicle and other validation actions.
- ii. Incident Management
 - a. The GUI shall be so designed that it shall be possible for the Supervisor to view at least the following information corresponding to each incident:
 - Plaza ID
 - Lane ID
 - User ID (of the user who was logged in lane at the time of incident generation)
 - User Name (corresponding to above User ID)
 - Transaction Number
 - Transaction Date & time
 - TLC Class
 - TLC / TAG VRN
 - TLC MOP
 - AVCC Class
 - Axle Count
 - Processed by (User ID of the Supervisor who processed the incident)
 - Supervisor Name (corresponding to Processed by User ID)
 - Corrected Class
 - Corrected VRN
 - Supervisor Action
 - TAG Media ID

- ICS image (with watermarked Date / Time stamp, transaction number, incident type, etc.)
 - LPIC image (with watermarked Date / Time stamp, transaction number, lane VRN, etc.)
 - Event details (events / anomalies associated with this transaction – each transaction starts when Valid TAG Media is detected – for media based transactions / AVCC Loop is triggered – for violations and ends when the vehicle liberates the AVCC loop)
- b. For processing of incidents / review of processed incidents, the Supervisor can filter the list of incidents based on the following:
- Plaza ID (Default – All) Drop down menu form
 - Lane ID (Default – All) Drop down menu form
 - User ID (Default – All) Drop down menu form
 - Transaction Date & time duration – From & To (Default – Current Date) User configurable
 - TLC Class (Default – All) Drop down menu form
 - TLC MOP (Default – All) Drop down menu form
 - AVCC Class (Default – All) Drop down menu form
 - Axle Count (Default – All) Drop down menu form
 - Processed by (Default – All) Drop down menu form including blank which shall be the case until incident is processed.
 - Corrected Class (Default – All) Drop down menu form including blank which shall be the case until incident is processed.
 - Supervisor Action (Default – All) Drop down menu form including blank which shall be the case until incident is processed.
 - Event details (Default – All) Drop down menu form
 - Processed Incidents / Not Processed Incidents
- c. In addition to the above, it shall be possible for the Supervisor to search for a particular record based on any / combination of the following search criteria:
- User ID
 - Transaction Number
 - TLC Class
 - TLC / Media VRN
 - TLC MOP
 - Processed by
 - Corrected Class
 - Corrected VRN
 - Supervisor Action
 - TAG Media ID

- d. Based on the MOPs defined in the system and the Incident configuration, it shall be possible for the Supervisor to correct the class of the vehicle, Vehicle Registration Number (VRN) and Confirm / Reject the Lane MOP.
- e. The incidents can normally be processed by Supervisor by performing selections / feeding information on one and / or all of the below fields:
 - Corrected Class
 - Corrected VRN
 - Comments (optional)
- f. It shall be possible for the Supervisor to perform these actions only by double clicking on a particular incident to view all information in detailed view before processing the incident.
- g. It shall be possible at Plaza ETC system level to configure following on selection menu basis in order to activate and deactivate by administrator level function:
 - Capture of ICS image none, for selected type of incident, for all types of incident, for all transaction.
 - Capture of LPIC image none, for selected type of incident, for all types of incident, for all transaction.
 - Record and report incident transaction at incident management system, none, for selected type of transaction, for all transaction.
- h. Other functions
 - In addition to the above primary function of the Supervisor, the following functions shall be performed by the Supervisor:
 - o Data Completeness
 - o Shift Consolidation
 - o Day Consolidation
 - o Month Closure
 - o Lists Transfer Status

The above functionalities are explained in detail below.
- j. **Data Completeness**
 - o The Supervisor can verify the status of data transfer between the lanes and workstations on an hourly basis. Wherever, the data transfer status is not OK, a separate process shall be available through which the Supervisor can re-request data transfer to correct the status.
 - o The Data completeness procedure shall check at least the following minimum items:
 - Transaction sequence jump
 - Transaction sequence reset

- Gap in time (if regular data packets are not updated), etc.
 - The Data completeness procedure needs to be defined and a separate document shall be provided by the TCE Supplier on how this feature is to be accomplished in the system.
- k. **Day Closure**
 - The Day Closure option is used by the Supervisor to close each Operational day. When the Supervisor selects this option, the system shall display the current status of Operation in terms of data exchange.
 - When, the supervisor closes the day, the following conditions shall be verified by the system before generation of Day Closure Report:
 - Data completeness
 - Data transfer to CCH completeness
 - If any of the above checks fail, the system shall display an alert (POP-UP) to the Supervisor to perform these pending operations before day closure.
 - This procedure shall ensure that no data generated is left unattended for review / reconciliation.
- l. **Month Closure**
 - Month closure is performed on a monthly basis on a complete calendar month. Once, this option is selected any day pending closure shall be brought to the notice of the Supervisor. For ensuring that all data and all corrections are complete and no deconsolidation whatsoever shall be required any further, the month closure for a particular month shall be performed on the 2nd day of the subsequent month (configurable).
 - Once, this operation is performed, no changes whatsoever can be made through the application to the transaction data of the corresponding month whatsoever. Deconsolidation option shall not be available and all manual overrides with respect to these transactions shall not be possible.
 - Whenever, this operation is confirmed, system shall ensure that this operation is performed after debt recovery. A warning message to this effect shall still appear for the Supervisor to ensure and confirm that the debt recovery process for the month for which month closure is being performed is already complete.
- m. **Lists Transfer Status**
 - In addition to the transaction data, there can be various lists related to users, media, classification, fare, configuration, parameters etc. which shall be transferred between server and workstations / lanes.
 - The status of all such lists shall be displayed on selection of this option. The status shall include the following:

- Name of the list
- Version of current transfer
- Version of previous transfer
- Date & time
- Frequency of transfer (in HH:MM format)
- Transfer Status
- It shall be possible for the supervisor to re-request / re-transfer any failed list transfers.
- Also, all lists shall be retained in the system along with date of activation and date of expiry in addition to the version details.
- All the above listed functionalities are the core responsibilities of the Supervisor and only he / she can perform the above functions. Any user of a higher user-group though can view the actions performed by the Supervisor / current status but cannot modify anything unless explicitly so mentioned.

n. **Fare Table Management**

- The following functions shall be performed by the Toll Manager:
 - Fare table management (updating / revision subject to Project Manager authorization in the system through his login)
 - Whenever a new version of fare table is generated, the old fares and contracts shall be picked up by default. It shall be possible for the user to further modify these fares and set the date / time of activation.

o. **Other Toll Manager Functions**

- Incident Management.
The Plaza manager can view and access all features / options of this function. However, he / she cannot perform any modifications / corrections.
- Data Completeness.
On certain conditions when the Data completeness status cannot be corrected due to false triggers, non-revenue data missing, revenue data missing, etc., an option shall be available for the Plaza manager to manually override such statuses in order to restore the operational flow.

p. **Users Management**

The following are the various user groups that shall be available in the system:

Operations	Finance	System
Project Manager	Finance Manager	Administrator

Toll Manager	Cashier	Maintenance
Supervisor		

When the user is created for the first time, all the information below is mandatory.

- Name
- Address
- Date Of Birth
- Contact Person
- Contact Number
- Email ID (optional)
- User ID
- Activation date
- Valid upto

The status of account and Date of creation shall be displayed against all the existing users in the system. User account can never be deleted from the system once created, as there can be operations / transactions performed by the user that exists in the database and is required for reporting purposes.

q. **Administrator Functions**

In addition to the normal functions listed above, administrator can perform the following operation:

- Lists Transfer Management: The administrator can manually copy the latest version of lists from the local ETC Server and restore the same in all the lanes.
- Incident reporting levels: The system will allow the assignment of a level of importance to each incident and also define if the incident should be acknowledged by the supervisor. The system has different levels of importance that can be assigned to different types of incidents. They shall be colour coded to facilitate easy visualization by the supervisor.

r. **Incident Recording**

ICS image capturing start from loop occupation to loop liberation and an additional configurable time limit after loop liberation of that transaction. Image capturing shall timeout after 30 seconds (configurable) after loop occupation irrespective of the above condition.

s. **System Configuration for Incident management**

One number of Incident management workstation with following minimum

configuration and peripherals shall be installed:

- Make : Reputed Branded
- Grade : Workstation
- HDD : based on estimated storage requirement for 6 months data (at least 160 GB in case estimated capacity is lesser) of latest RPM
- RAM : 4 GB or latest
- Processor: latest Intel Processor
- Processor speed : latest available in the market at the time of delivery to the site
- CD ROM: latest available
- PCI Slot: 2 Nos. Spare
- USB Port: 4 nos.(high speed)
- NIC : 1 Gbps On-board
- RS232 port: 2
- LPT port: 1
- PS2 port (mouse): 1
- PS2 port (keybrd): 1
- Monitor: Colour 17" TFT
- Mouse: Optical
- Keyboard: Standard

30. Management Software Specifications

The key features of the Toll Management Software (TMS) are as below:

- i. Highly secure and reliable system - Integrated Dashboard to monitor real time cash collection along with ETC transaction with checks and balances and data archiving options.
- ii. Convenience of Plug and Play feature - Support easy integration with various existing all ETC infra equipment/ software at toll plaza, interface with complementary systems for TMS performance management.
- iii. Centralized remote real-time System monitoring of toll collection, Lane & Plaza level equipment availability status, software sub-modules, etc.
- iv. System shall work to support Closed Toll Collection System automatically deduct double toll fare for cash vehicle passing through the FASTag express lane.

- v. Focused on enhanced ETC performance - Support for both the existing SFTP-based communication (as per ICD 2.4 document) and the proposed API-based communication (as per ICD 2.5 document).
- vi. Scalable to other electronic media - Use of other ETC media e.g. Contactless Smart card (e.g. NCMC), QR based payment, mobile ticketing etc. for rapid toll payment.

30.1 System Requirements

The system should meet the following general requirements:

30.1.1 General Requirements.

- i. The information flow should be designed to ensure that the system can operate with minimum bandwidth (128 Kbps) for access and operation.
- ii. The System should be deployed as easy-to-use plug and play application at Plaza servers. These applications should automatically transmit report related data to a Central system at each minute for reporting and dashboard purpose.
- iii. System should be interoperable with various systems deployed across toll plazas.
 - a. AVCC interface
 - b. MSWIM interface
 - c. RFID transponder
 - d. Acquirer systems related to various electronic transactions
 - e. Payment gateway
 - f. Smart cards
- iv. The User interface of the web-enabled parts of the system should be designed to open in at least the following standard/popular browsers:
 - a. Microsoft Internet Explorer
 - b. Mozilla Firefox
 - c. Google Chrome
 - d. Apple Safari
- v. The System should have accuracy in the capture, processing, communication and reporting of Toll Transactions and associated information as per defined standards.
- vi. The System should have features to ensure integrity and reliability as per

defined standards in conditions like high humidity, dust, rains, temperature variations and other adverse conditions that may happen in the Toll Plaza.

- vii. The System should be browser independent to the extent possible, the look and feel and the accessibility of the application should be similar across browsers.
- viii. The System should automatically detect access by mobile browsers and adjust contents accordingly.
- ix. The System must allow archival, retention and deletion of records as per policy of retaining records for a period of 10 years.
- x. The System should be designed in a modular approach to ensure that it can easily interface with new IT applications and systems that may be implemented during the project lifecycle.
- xi. The System should be scalable to other electronic media - Use of other ETC media e.g. Contactless Smart card, QR based payment, mobile ticketing etc. for rapid toll payment.
- xii. The System should have convenience of Plug and Play feature – Support easy integration with various existing all ETC infra equipment/ software at toll plaza.
- xiii. The System should be integrated with mobile wallet.
- xiv. All webpages should have pop-in as well as separate help menus to help users navigate easily across the system.
- xv. The System should cater to various solutions as required by Acquirer Bank as per ICD 2.4/ ICD 2.5.
- xvi. The System shall have provision of Data archiving as described below:
 - a. Summarized data shall be archived on removable media on a regular basis so as to free system resources. All plaza level data shall be transferred to removable electronic media at monthly intervals and stored. The archived data should be secured as per Data Encryption Policy of 2017 (https://www.meity.gov.in/writereaddata/files/Guidelines-Contractual_Terms.pdf).
 - b. After expiry of the prescribed period for retention of the data on the various system levels, the data may be removed from the systems. The TMS backend shall provide the facility to perform these functions. The archived data written to the electronic media shall be fully accessible by the TMS and the various reporting facilities of TMS without the necessity of having to restore the data.

- xvii. Data should be retained with the following frequency, at a minimum:
 - a. TMS Lane Level : 3 months
 - b. TMS backend Detailed Data: 12 months
 - c. Summarized Data : 24 months
- xviii. The System should have adequate backup and redundancy provisions. All transaction and incident data shall be retained, duplicated and stored within the various levels of the TMS such that should any level or component of that level suffer a partial or total failure, the data is not irretrievably lost to the system. In addition, it shall be possible to reconstruct and restore the data for the failed level from the stored data into its original format.
- xix. The Graphic User interface on the Toll Collector Terminal shall be clutter-free and shall use colours with adequate contrast so as to cause minimum fatigue to the toll collector over the duration of their shift. The high contrast shall also make the TCT screen display adequately visible during a high incidence of ambient light like when sunlight directly falls on it. All the displayed text and graphics shall be large enough to be recognized easily.
- xx. The System shall incorporate features that will enhance the toll collector's productivity while performing repeated transactions over the shift period. These shall include, at a minimum:
 - a. Minimum key presses to complete a cash transaction
 - b. Large on-screen text and graphics size
 - c. Optimum arrangement of keys on the TCT keyboard
- xxi. The System should adhere to best in class performance requirements. The minimum standards are specified as follows:
 - a. Time for the Toll Receipt to be printed: Less than 1.5 seconds after payment confirmation on the TCT by the Toll Collector.
 - b. Maximum time for validation of a Return ticket / Daily pass: 0.5 seconds.
 - c. Maximum read time of FASTag (from vehicle arriving over the presence loop and the barrier opening): 1 Second.
 - d. Maximum time for Open loop Contactless Smart Card transaction (Offline) (from the time the card is presented to the validator to the barrier opening): 5 seconds.
 - e. Any response on GUI to Toll collector key press on the TCT: Less than 1 second.
 - f. Maximum transaction completion time from vehicle leaving the AVCC area until the system getting ready for the next transaction: 1 Second.

30.1.2 System performance while Vehicle Processing and Plaza Operations

- i. The System should perform the following operations, in the following sequence,

for processing a vehicle at the Toll Plaza:

- a. The Boom Barrier should be closed.
 - b. The System should check if the vehicle can be processed via electronic transactions. If the vehicle can be processed electronically, then **Error! Reference source not found.** related rules should be followed.
 - c. For vehicle that do not have active electronic payment modes, **Error! Reference source not found.** related rules should be followed.
 - d. The Vehicle's fare should be displayed to the Lane Operator and vehicle user.
- ii. The system should provide Closed System of Toll Collection for expressways.
 - iii. The System should automatically capture the following minimum details associated with each transaction:
 - a. Date and time
 - b. Plaza and lane ID.
 - c. A sequential number assigned based on the data above.
 - d. Vehicle classification (by toll Collector or as read from the FASTag and that received from the AVCC in both cases).
 - e. Discrepancy in vehicle classification, if any.
 - f. Vehicle number, if captured by LPICC or manual entry.
 - g. Toll Collector ID in case of manual user fee collection.
 - h. Fine/Penalty and another amount charged
 - i. Method of Payment: FASTag/CASH/ETC-Card/etc.
 - j. Exceptional transaction (exemption, convoy and other cases)
 - iv. The System should automatically transmit the following details regarding the lane to a monitoring system at a Central location:
 - a. Lane Mode: Open/ Closed/Maintenance.
 - b. Status of following equipment:
 - Lane Controller
 - Boom Barrier
 - RFID transceiver
 - Weight in Motion (WIM) equipment
 - Automatic Vehicle Counter & Classifiers (AVCC)
 - Internet connectivity (via lease line/dongle/etc.)
 - c. Total collections via cash/electronic mode since last transmission / for

- the day.
- d. Number of vehicles processed since last transmission.
 - v. The System should also have features to identify lanes that are not transmitting the above information as per frequency and issue alerts as per defined strategy.
 - vi. The system should support following components/ devices for the operations:
 - a. An Overhead Lane sign (OHLS) / Canopy Lane Status Display (CLSD) that indicates to an approaching road user whether the toll lane is open for toll collection or it is closed and if open.
 - b. An Automatic Lane exit Barrier (ALB) that allows the road user to leave the lane after toll payment.
 - c. A traffic light (TL) with Red and Green aspects, that indicates to the road user whether the vehicle should remain at the toll lane or can exit.
 - d. The system should also have features for traffic control and guidance of toll paying vehicle through the toll lane.

The OHLS sign should display the following details:

S.No	OHLS	Automatic lane exit barrier	Traffic Light	Traffic control / guidance
1	Red	-	-	Don't enter lane
2	Green	Closed	Red	Stop /wait at toll booth (pay axis)
3	Green	Open	Green	Cleared for Exiting the Toll lane

30.1.3 Electronic Tags processing.

- i. The System should interface with the RFID transceiver installed at the toll plaza to receive the following details regarding an RFID tag:
 - a. TID
 - b. EPC Code
 - c. User Code
- ii. The System should automatically determine if the Tag is in the Exception list based on Exception list file inputs from the NPCI. Alternatively, the system

should also have provision to push the TID/ EPC code to designated servers and get the response.

- iii. The System should have flexibility to be interoperable with new electronic processing systems based on technologies like EMV/ Credit / Debit card (supporting online transactions). For such technologies, the System should have features to push the relevant code read at the Plaza to the electronic processing system (e.g. Acquirer) via API push and accept the response via API pull.
- iv. The system shall also have the feature of integration with local Smart card validators (located on the same Toll lane) capable of generating off-line smart card (e.g. contactless, Open-loop, EMV/Rupay bank card) transactions. In this case the system shall send the vehicle class read from the FASTag or through other means, to the validator via a local data link (RS 232/ TCP/IP).
- v. The System should automatically open the toll gates for non-blacklisted vehicles, or if the Central Server send the signals to open the gate.
- vi. System should deploy the following logic for handling the Exception List files. The TMS shall periodically download the Exception files from their respective Acquirers. On obtaining the FASTag details from the RFID transponder the system shall verify the Tag's ID (based on the EPC code/ TID code) in the current Exception list present in the system. If not found the system shall store the read-in FASTag details for transmission to the Acquirer.
- vii. If the Tag's ID is found in the Exception list, the System should offer other modes of Electronic transaction (e.g. off-line/ on-line Smart card pre-paid / Credit card / Debit card -based transaction). If the user does not avail of any of these or if they fail during an attempt, the system shall offer cash-based transaction for the user.
- viii. System should have the capability to capture the information regarding vehicle overweight by fetching the data from the MSWIM system and add the applicable penalty to the payable amount. The System should also display the word "Overload Vehicle" prominently at the lane display.
- ix. The vehicle owner/driver should have features to protest the fine and get the vehicle weighed at a SWB. In case, the vehicle is not overweight at the SWB, the System should send message to Acquirer Bank via automatic integration/manual input, to reverse the transaction and initiate a new transaction without the penalty amount.
- x. The System should have the capability to automatically calculate the fare details based on the toll plaza, time of operation and distance travelled on the expressway.

- xi. System should be able to calculate penalties if a non FASTag vehicle has entered the FASTag lane as per guidelines on the subject.
- xii. The System should have feature to alert the customer, Issuer Banks, and NPCI in case of following potential frauds:
 - a. The tag has been used across different toll plazas within 15-minute window.
 - b. The tag is used across toll plazas that are not frequently used by the customer.
 - c. The tag has been used after a considerable period of non-usage.
- xiii. The System should have features to automatically push the captured images to the TMS backend and tag them with FASTag number, time of operations, lane number and the unique transaction number.
- xiv. The System should automatically alert the Lane Operator in case of following issues:
 - a. Vehicle is overweight
 - b. The vehicle class as derived from the Mapper and the class from profiler does not match.
 - c. Vehicle has been over speeding.
 - d. Vehicle has been highlighted by NHAI/ IHMCL/ other agencies.
- xv. In case the System has issued alerts, the Lane Operator should have option to close the lane and prevent the vehicle from passing. If the above is not possible, then the System should automatically alert designated authorities for necessary actions.

30.1.4 Fare Calculations and Cash Operations

- i. As the vehicle approaches the Pay-axis on the Toll Lane, the Lane operator in the Toll booth classifies the vehicle on the TCT keyboard. The System shall also capture the videos/images of such vehicles and tag them with transaction time, and vehicle number (as captured via LPICC/ manual entry).
- ii. The system should have features to automatically detect the vehicle number via ANPR based system and show the same on the screen. In case of issues, there should be provision for the operator to enter the vehicle number. The operator should have provision to skip the number entry, if required. However, the system should mandatorily require the input/capture of vehicle number in case the Class has been over ridden.
- iii. The system shall have the facility to automatically calculate the fare based on the following details:

- a. Toll plaza
- b. Class of vehicle
- c. Distance travelled on the expressway
- d. Time of operation
- e. Vehicle weight
- f. Return journey
- g. Cash vehicle entering the ETC Lane (double the Toll amount)

It is possible that all the above parameters or a subset among them may be used for fare calculation. It shall be possible to configure the system accordingly during system commissioning.

- iv. System should be configurable to configure customized Toll fares at each individual toll plaza for different category of vehicle as per toll guidelines issued from time to time, and automatically push the same to individual Toll Plazas from a central system.
- v. System should have feature to receive the images from various toll plazas and store them at a Central location. The images should be tagged with transaction based on the time stamp and the toll plaza/lane location. The retention period for these images shall be 90 days, or till the dispute (associated with the transaction) is resolved, whichever is higher.
- vi. System should have the capability to accept the information regarding vehicle overweight, with the Vehicle weight received from the MSWIM and add the applicable penalty to the payable amount.
- vii. The system should have features to perform the following activities upon receipt of cash by the operator:
 - a. Enter the cash received
 - b. Display the change payable
 - c. Open the cash register
 - d. Print the Toll receipt
- viii. The System should automatically alert the Lane Operator in case of following issues:
 - a. Vehicle is overweight
 - b. Vehicle has been over speeding
 - c. Vehicle has been highlighted

- d. The vehicle class is different at different plazas
 - e. Open the Boom Barrier
- ix. In case the System has issued alerts, the Lane Operator should have option to close the lane and prevent the vehicle from passing. If the above is not possible, then the System should automatically alert designated authorities for necessary actions.
- x. The System should have features to handle following categories of exceptions and calculate fare as per instructions given by the authority:
 - a. Single Journey/Return Ticket / Daily pass
 - b. Monthly Pass
 - c. Local vehicle Pass (concessional Toll)
 - d. Exempt Vehicle

The system should be able to perform the above calculations for both electronic and cash-based payments.
- xi. The System should have features to handle Convoy vehicles via the following approach:
 - a. Lane Operator should be required to press the Convoy button to start the transactions.
 - b. Alert the supervisor regarding Convoy operations.
 - c. Capture images and videos and mark them accordingly.
 - d. Continue the operations until the Toll Operator presses Convoy key followed by the 'accept' key, post which the system should resume normal operations.
- xii. The System should have features to capture details of “run-through vehicles” that pass the Toll Plaza without paying toll. The System should automatically capture images of such vehicles and send relevant authorities at the end of day. The above features should also be available for vehicles that have been classified inaccurately.
- xiii. The System should have features to accept “Towed vehicles”, such vehicles should be processed only via cash. Even if the Vehicle has a FASTag, or electronic payment instrument, the System should not send the transaction for processing. The following steps should be adopted for processing these vehicles:
 - a. The Toll Collector Presses Towed Vehicle key.
 - b. The Toll Collector enters number of vehicles being towed and their

- class.
- c. The System displays the total amount payable.
- d. Toll Collector confirms receipt of due amount.
- e. Boom barrier is opened.
- f. The loop sensors allow Boom Barrier to be opened till the entered number of vehicles have passed.

30.1.5 Plaza/ Lane Management Module

The Lane management module should have the following features:

- Login/Logout
 - Toll Collector/Toll collector
 - Supervisor
 - Maintenance
- Lane Mode /Configuration
 - Hybrid Lane (supporting Cash, and ETC)
 - ETC Lane (Dedicated)
 - Cash (Semi-Automatic)
- Mode of Operation
 - Idle/Closed Mode
 - Open Mode
 - Local Mode
 - Local Mode Without TMS (Server)
 - Maintenance Mode
- Mode of Payment
 - Cash
 - Local/Monthly Pass
 - Smart card
 - Barcode/QR code - Multiple/Return journeys
 - Credit card/ Debit Card
 - Wallet
 - FASTag / Electronic mode/Other electronic mode
 - National Common Mobility Card
 - Exempt

- Journey Type
 - Single
 - Return
 - Exempt
- Emergency/Authorized Exemption
- Non- Emergency/Local Exemption
 - Violation
 - Multiple
- i. The following steps should be performed to complete the login of the Toll Collector:
 - a. The Toll Collector scans his card and/or scans the biometric sensor.
 - b. The Toll Collector enters details of the cash-in-hand before starting operations.
 - c. The supervisor verifies the above details via biometric verification.
 - d. System maintains a log of above events and their respective time.

When a lane is tagged as “Under Maintenance”, no operations are allowed on the same till the above is completed. Post completion of the above steps, the lane operations can resume and the lane mode changes from “Under Maintenance” to “Operations”.

- ii. The following steps are performed once the Toll Collector finishes the duty, or takes a temporary break:
 - a. Toll Collector selects the “Log Off” option and verifies the same via biometric, and/or card input.
 - b. System puts the lane under “Maintenance Mode” and no operations are allowed.
 - c. A report is generated of the total cash collected. The report also displays the total cash expected from the Toll Collector.
 - d. The supervisor accepts the log off activity.
 - e. The lane remains in “Maintenance Mode” till a new login is performed on the same.

The System prompts the supervisor to tally the cash collected and automatically adds the above to the total amount to be submitted in the Bank.

30.1.6 Plaza Activity Module

The System should have features to perform the following plaza related activities:

Admin Activity.

- Authorize Staff - to add new staff /add authorization levels.
- User Rights - to add/ remove/ update rights of various users.
- User Rights Report - to generate report of various system users and their rights.
- Unlock Shift - manually treat shift as complete if the operator has to leave due to emergency.
- Release Login - release the plaza from systems' preview as per instructions.
- Vehicle Tracking - capture details of vehicles being tagged in the system.

The System should have features to ensure that the activities above capture the details of various instructions issued by the Authority related to the activity.

30.1.7 Finance and Accounting Module - General Requirements

- i. The System should have the provision for not to allow the vehicle to pass in case the funds are not sufficient for operations for dues, or if the tag has been debarred by Authorities.
- ii. The System should also create a provision where the above control can be overridden to varying degrees (like part payment accepted, no payment accepted) based on approval received from the appropriate authority.
- iii. The System should have a provision for requesting such relaxations for pre-defined reasons which will then be approved by appropriate authority.
- iv. The System should have provision to create, edit, delete predefined reasons.

30.1.8 Accounting Requirements

- i. The System should facilitate definition and configuration of the Chart of Accounts (CoA) to capture all financial transactions pertaining to the Operators/User. The CoA should have multiple level and the levels should have hierarchical relation i.e. parent-child relationship.
- ii. Facility for creation, modification and deactivation of CoA should be available.
- iii. Newly created CoA should be automatically available for payment deposit, payment posting etc.

- iv. The System should facilitate the system to automatically transfer the due amount to an escrow account and transfer the amount to Vendor as per specifications of the Authorities.
- v. The System should maintain electronic payment register, cash book, ledger accounts and sub ledger accounts, as the case may be, for each Operator as applicable.
- vi. The System should update the payment register as soon as it becomes due and must automatically update the cash book and ledger account for each Operator based on the payment made or reconciliation.
- vii. The System should capture/post the accounting transaction as per the defined chart of accounts.
- viii. The System should capture the timing of each transaction.
- ix. The System should ensure prohibition of CoA use based on the user profile.
- x. Facility should provide to adjust the advance with multiple payment head (fully or partially).
- xi. During partial payment, the System should appropriately handle penalty, interest and fees.
- xii. The System shall implement mechanisms to split and allocate the total amount received from the User to the respective transactions, if User has paid a lumpsum /consolidated amount for multiple transactions together.
- xiii. The System should have capability to handle payment and accounting of each offices separately.
- xiv. The System should automatically post different components (Fee, penalty, tax etc.) of a transaction in respective heads of account.
- xv. The System should have facility for segregating revenue earned component and tax payable component to enable authorities to calculate their tax deposit liability.
- xvi. The System should automatically compile the accounts statement and reports at the level of Head Office, Regional Offices, User, Operator, Service Types, etc. for each financial year.

30.1.9 Payment Reconciliation

- i. The System should reconcile the operations at a toll plaza with ETC amount debited from the customer. The system should automatically issue alerts to the operator and relevant authorities in case of any issues.
- ii. In case of mismatch between debited and demanded amount, the lesser of the two should be highlighted to the Operator for raising disputes, if applicable.

- iii. The System should have the facility to capture / upload bank statement/ transaction detail from bank's software/ web services /External drive etc.
- iv. The System should have facility to link its own financial record with the bank transaction record and reconcile the same.
- v. Failed reconciliation is to be reported.
- vi. Facility should be provided for auto reconciliation of batch data or reconciliation by manual selection of payment detail.
- vii. Transaction should be posted in cash register once the reconciliation is complete.

30.1.10 Integration Module

i. Financial Partners

- a. The System should have features to calculate the following details for any Lane/Plaza at any point in time:
 - o Cash issued to the Lane Operator.
 - o Cash expected from the Lane Operator (basis vehicles passing through the plaza).
- b. The System should enable designated officials to view the above report and verify if the cash expected was received. The System should also have features to enter number of currency notes/ coins designation received from the Toll Collector and tally the results.
- c. The System should have designated module to enable cash submission at the bank. This module should automatically display number of various currency/note denominations and the total amount to be submitted at the bank.
- d. The System should have features to integrate with the bank statement (excel/ xml/ csv) and confirm the details of submitted amount versus bank details. The System should automatically flag transactions that do not match or do have corresponding statement.

ii. Technology Partners

- a. The System should have features to integrate the system with Tag registration mobile application of relevant authority.
- b. In addition, the System should also have capability to integrate (by exposing APIs) with additional applications defined by the relevant authority, subject to the overall transaction volume not exceeding ten

times of current load, as a result of the changes.

- c. The interface to the FASTag transaction Acquirer system is implemented on TCP/IP over a public internet. The transaction processing and interfacing with the Acquirer system shall meet all relevant requirements included in the following documents:
 - Procedural Guidelines, National Electronic Toll Collection Network (NETC Network), version 1.7, Jan 2018.
 - Central Clearing House (CCH) Interface Control Document, version 2.4 (or the current version).
- d. The TMS shall provide secure interfaces via a TCP/IP link (dedicated link / VPN/ Public internet) for authorized remote monitoring systems to acquire data from it in real time. The data required will include all those captured in the TMS including TMS lane system performance data, Toll collector performance data, traffic data including Toll Plaza throughput, Transaction data, financial data and all relevant data to determine all aspects of Toll plaza performance including its operational efficiency and effectiveness.
- e. The TMS shall provide performance monitoring via the Lane Status Display Unit. This will involve the comprehensiveness and the level of detail the TMS provides for on-line system performance monitoring.
- f. The TMS shall provide flexibility to define toll fee tariffs over and above the authorised toll fee tariff table which will enable extending of tariff table to include more vehicles (e.g. two wheelers, three wheelers) and toll schemes (e.g. Toll Tariff depending on day of week, time of day can be predefined and stored in system for activation on a specified date).
- g. The TMS shall provide on-line transmission of FASTag Vehicle Identification records from the lane controller to the TMS server. On-line transmission to TMS server results in quick transfer of vehicle identification records to the Acquirer system thus resulting in faster updates of exception which in turn enhances road user experience as well as reduces the potential of chargebacks.
- h. The TMS shall provide Live Performance Monitoring of the TMS. This feature helps monitoring the lane-wise Toll Plaza traffic on-line.
- i. The TMS shall provide option to select lane operation mode which will help in configuration of the different modes of lane operation (e.g. Hybrid, Dedicated etc.) proposed. For example, in case of failure of a Dedicated FASTag lane, an adjacent Hybrid lane can be quickly configured to be a Dedicated lane, until the original Dedicated lane is set right.

- j. The TMS toll products shall be configurable which will allow new toll products / schemes like time-based (e.g. Weekly pass, Monthly pass) or Trip-based (Limited trips) or a combination of both (e.g. Monthly pass with limited number of trips) can be introduced.
- k. The TMS shall enable user configurable toll vehicle classes i.e. new vehicle classes can be introduced into the system and can be effectively implemented provided the AVCC system can uniquely classify them with a high level of accuracy.
- l. The TMS Toll collector user interface shall use high contrast between graphics/text and the background for easy readability even in the presence of high ambient light. Toll collector interface should facilitate easy readability and high contrast enhance toll collector efficiency and reduce toll collector fatigue.
- m. The TMS should capture presence of a Media (RFID) for audit. For example, whether a single daily pass is fraudulently shared by several vehicles and mis-used or daily pass that is paid by cash (with a printed barcode on a receipt) or even with a FASTag affixed to a portable glass plate and shared between vehicles. The system should have functionality to highlight and mark such records for enabling authorities take necessary steps.
- n. The TMS should have functionality for transaction audit and availability of evidence. The Auditor in the TMS has the responsibility of resolving incident / violation transactions like:
 - o Where AVCC class does not match with the Toll Collector class (in case of cash transaction) or when AVCC class does not match with the vehicle class written on FASTag.
 - o When a vehicle has been exempted from paying toll by the toll collector.
 - o When a vehicle has 'run through' a toll lane without paying toll.

The TMS should provide a rich list of evidence to the Auditor including Vehicle Image/ Video, License Plate, AVCC profile, WIM Measurement, SWB measurement to help auditor make an informed decision.

- o. The TMS should facilitate user customizable report. Such a feature aids the user to generate specific analytical reports that provide a better insight into the TMS performance for its improvement. Such reports may not be a part of the standard list of reports present in the TMS but can be customized as per requirement.

- p. The TMS shall provide web-based performance monitoring and transaction audit feature for remote performance monitoring and transaction auditing.
- q. The TMS shall have functionality to detect and highlight error in Lane Status Display Unit (used for performance monitoring) through which an issue alert shall automatically be sent to the authority.

30.1.11 System Integration

The System should have features to integrate with the following peripherals:

Ser. No.	Device	Typical connection type from the System (as per specification, or similar solution)
a.	Incident Camera & License plate recognition camera	TCP/IP
b.	User Fare Display	RS 232
c.	Automatic Lane Exit Barrier	Digital I/O
d.	Traffic Light	Digital I/O
e.	Over Head Lane Signal (OHLS)	Digital I/O or data link using RS 232/RS 485 or TCP/IP
f.	Credit/ Debit/ CSC/NTC reader / validator	RS 232 or TCP/IP
g.	AVCC system data	Via RS 232 to Lane controller and TCP/IP to the TMS backend. OR Via TCP/IP to both the Lane controller and the TMS backend.
h.	TLC / AVCC door status	Digital input

30.1.12 The above interactions should be via secure/encrypted communication protocols.

30.1.13 The above requirements are indicative, and the System designers can recommend new backward compatible connectivity protocols for the above equipment basis the latest industry protocols/ Indian requirements.

- 30.1.14 Although the main information transfer in many peripheral devices is only one way (i.e. output) from the TMS lane system (e.g. OHLS, TL, UFD), the TMS lane system shall support two-way communication and obtain the device status, in as much detail as possible, based on the hardware connectivity / Device driver / communication protocol provided by the device manufacturer/ vendor.
- 30.1.15 In general, the TMS shall communicate adequately to activate all possible controls/displays supported by the peripheral device/system and to obtain all possible information provided by the Peripheral device / System.
- 30.1.16 A non-response of the Device / system over the communication channel, it shall be tagged as an event and communicated on-line to the TMS backend. Further the restoration of communication shall also be tagged as an event and communicated on-line to the TMS backend.
- 30.1.17 The communication shall be secure to the maximum extent possible supported by the device connectivity.
- 30.1.18 Loop Failures (related to loop for Presence detection or AVCC or barrier) shall be automatically detected.
- 30.1.19 All such obtained device/ system status information, as detected and captured above, shall be transferred on-line to the TMS backend.
- 30.1.20 **Employee Module**
- i. **Configuration Dashboard**
- a. The System must support Role-based access for administrators and users.
 - b. The System should have facility for creating/editing/deleting Vehicle category, toll rates, plaza contracts, employee assigned, etc. so that the same may be used for toll calculations.
 - c. The System configuration module should be accessible only to a selected group of users across each department and office.
 - d. Every update in the System configuration should require approvals from a user at least one level above the updating user. All the changes should also be available for audit purposes.
 - e. By default, the System should populate the related fields of a form if one parameter is selected, therefore list of meta data should be created for all possible fields.
 - f. The System should have facility for creating/ editing/ deleting fee rates for various services rendered by the Authority.

- g. The System should keep history of year wise fee rate and facilitate automatic calculation of fee for a given year for a given service,
- h. The System should have facility for creating/ editing / deleting various rate of penalties or interests relating to specific service, time period etc.
- i. Facility for multiyear fee, penalty and interest calculation should be provided considering variable rate for multiple year.
- j. The System should have facility for creating /editing/ deleting Account Head or Chart of Account (CoA).
- k. The CoA should have hierarchical relation between its various levels.
- l. Facility for creating relation between CoA and services/fees should be provided.
- m. The System should have facility for creating/editing/deleting document list required for various application type/ service type and the minimum information that needs to be captured in the Form for each of the applications.
- n. The System should facilitate creation and modification of workflows related to activities like changes in new plaza, updates in fare rules, modification in issuer banks list, etc.
- o. The System should have facility for creating/editing/deleting various roles, users etc. for System use. Systems should also have facility for creating/editing/ deleting tasks and linking/assigning the same with roles/users.
- p. The System should have facility for creating/editing / deleting linkages between roles, users, workflow etc.
- q. Facility should be there for assigning, reassigning, activating, deactivating etc. for various task, users and roles.
- r. The System should have facility for creating/editing/ deleting list of standard comments/ reasons and facility to link it with various task/workflow etc.
- s. The System should facilitate definition, configuration and criteria setting for the key events and related alert or messages.
- t. The System shall facilitate making necessary changes to the existing structure for fee, fines and other charges based on the revisions in the policy.
- u. The System should have facility to define and configure exemptions, rebates, special cases etc. for various transactions and also for financial matters. During various processes/operation in the System, these exemptions, rebates should be automatically considered.

- v. The System should provide provision for creating, editing, deleting various type of commissions for different transactions.
- w. The System should have facility for creating vendor/ contract users and their commission for different type of transactions.
- x. The System must maintain an audit trail of all updates in the meta data.
- y. The System shall require following additional security mechanisms for following categories:
 - One-time password for critical approvals (for example updating the toll rates).
 - Digital signatures for senior management.

ii. **Workflow Approvals**

- a. The System should facilitate creation and modification of workflows.
- b. Facility should be there for assigning, reassigning, activating, deactivating etc. for various task, users and roles.
- c. The System should have facility for creating/editing/ deleting various roles, users etc. for the System use.
- d. The System should have facility for creating/editing/ deleting linkages between roles, users, workflow etc.
- e. The System should have facility for creating/editing/deleting tasks and linking/assigning the same with roles/users.
- f. Definition of transactions should include issuing unique identification code to the transaction, name of the transaction, brief description of the transaction, etc.
- g. The System shall facilitate definition of master list of transactions under the respective service types.
- h. The System shall facilitate definition and configuration of mandatory transactions from the master list of transactions including its periodicity.
- i. The System should enable many relationships between various activities, roles and users.
- j. The System should have facility for re-assigning any task to other relevant user from the front-end GUI to handle absence of any user on a particular day.
- k. The System should have facility for creating/editing/ deleting list of standard comments/reasons and facility to link it with various task/ workflow etc.

- l. The System should facilitate definition, configuration and criteria setting for the key events and related alert or messages.
- m. The System should enable linear as well as parallel approvals.

iii. **NMSCEL Dashboard**

- a. The System shall have an online workspace for each of the designated employee within NMSCEL.
- b. The entry to the dashboard should be via employee ID and password.
- c. For certain employee categories, the System must only allow entries to machines that have a security certificate installed on the machines.
- d. The System should automatically require password reset after 90 days.
- e. The dashboard shall present the following information to employees by pushing relevant information from Plazas to a Central System:
 - Different disputes/issues regarding payment reconciliation.
 - Role base hierarchical dashboard.
 - Status of ETC toll plazas across various tolls plazas under the jurisdiction of the employee. The status should display the following information, at a minimum:
 - Plaza Name.
 - Number of lanes.
 - Lanes where ETC equipment is not functional.
 - Lane-wise name of the non-functional equipment.
 - Contact details of following – Vendor and IHMCL/NHAI employee.
- f. Integrated Dashboard to monitor real time cash collection across different toll plazas along with ETC transaction and health status of ETC equipment installed at each toll plaza.
- g. Reporting dashboard with (at least) following reports:
 - Revenue target vs. actual revenue generated
 - Plazas with maximum issues with ETC lanes
 - Resolution time for the ETC issues.
- h. The reporting dashboard should have a hierarchical integration. For example, supervisor should be able to see reports for all reporting

employees at an individual and aggregate level.

- i. Following additional reports should be available for senior management across with option to split the same across department/plaza operator/region
 - Revenue targets vs. actual collection across ROs/ PIUs.
 - Override reports across offices.
- j. The management dashboard should also be hierarchical and allow senior management at Central office to view reports across all offices, while regional offices should be able to see only their data. Similarly, the views of department heads should be restricted to their departments.
- k. The management dashboard should have option to select any/all of the following items and generate the report(s):
 - Time
 - Office
 - Revenue
 - Transaction type
 - Vehicle type
 - User Type
 - Plaza Operator
 - ETC Equipment
 - Account Heads
- l. The dashboards should have easy to use Graphical User Interface to customize reports and make comparisons.
- m. The dashboard should also display KPI adherence for all the KPIs defined under the provision of Operation and Maintenance, for identified users.
- n. The dashboard must have facility to generate on-demand reports based on criteria defined above.
- o. The dashboard must have facility to enable identified users to download data for archival purpose in an easy to use format (for example excel).
- p. The dashboard should also have the facility to define the frequency of report generation and the intended recipients. The System should then automatically email the reports to defined users.
- q. The System should have facility to allow only certain IP addresses to access some sections of the solution.
- r. The System should highlight tasks that have allocated to NMSCEL/

MSRDC officials via a pop-up window. They should have option to act on task or postpone for later. For tasks that have not been acknowledged within a time-frame. The System should highlight details to supervisor for reallocation.

iv. **System Dashboard**

- a. A System Dashboard shall be provided for defined class of NMSCEL/ MSRDC users. The System Dashboard should allow users to change the system configuration as per requirements/legislative changes.
- b. The entry to the dashboard should be via employee ID and password.
- c. For System Dashboard access, the System must only allow entries to machines that have a security certificate installed on the machines.
- d. The system dashboard should allow for editing of following Toll plaza details:
 - Add a new toll plaza.
 - Change the number of lanes.
 - Change the ETC lanes.
 - Change the Toll Operator.
 - Delete the toll plaza.
 - Edit the mapping between plaza and rates.
- e. The system dashboard should allow for editing of following Vehicle Class details:
 - Add a new Vehicle Class.
 - Drop a vehicle class.
 - Change the rates associated with the vehicle class.
- f. The system dashboard should allow for editing of following Toll Operator details:
 - Add a new Toll Operator.
 - Assign a Plaza to Operator.
 - Drop the Plaza from Operator.
- g. The system dashboard should allow for editing of following Employee details:
 - Add a new Employee.
 - Assign a Plaza to Employee.
 - Drop the Plaza from Operator.

i. Revenue Dashboard.

- a. The System should have module to generate the following reports, but not limited to:
 - Shift Collection Report.
 - Manual/Cancel Report.
 - Toll Time Collection Report.
 - Periodic system collection Report.
 - Transaction Report.
 - Periodic Transaction Report.
 - Day Collection Report.
 - Discrepancy Transaction Report.
 - ETC Collection.
- b. System should also have features to automatically integrate the above reports or to dissect the same at a plaza/project/PD level.

ii. Other Dashboards

- a. The System should have module to generate the AVCC reports:
 - AVCC comparison/Accuracy Report.
 - AVCC Traffic count Report.
 - Back up AVCC Transaction Report.
- b. There should be features to generate the following Traffic reports:
 - Lane Wise Report.
 - Class Wise Report.
 - Traffic Count Report.
 - Distance Travelled wise report.
 - Traffic count summary Report.
 - Monthly Traffic Report.
- c. There should be features for following Event reports:
 - Day Violation Report.
 - User Activity Report.
 - Exempt Vehicle Report.
 - Cash collection in FASTag exclusive lanes.
 - Total ETC Collection.
 - Total Cash Collection.

- Simulation History Report.
- Exemption Report.
- d. There should be features for following Audit Reports:
 - Audit Transaction Report.
 - Post Audit Collection Report.
- e. There should be provision for following WIM reports in the system:
 - Overweight Revenue Report.
 - Overweight Amount Summary Report.
 - WIM Transaction Report.
 - SWB overloaded Transaction Report.
 - WIM Transaction vs SWB Report.
 - WIM data received Report.
- f. The system should have features for following ETC reports.
 - Acquirer File Upload Download Details Report.
 - Acquirer File Transaction Report.
 - ETC Transaction Report.
 - TMS CCH Transaction Reconciliation Report.
 - Transaction Vs missing Reconciliation Report.
 - Vehicle number wise ETC Transaction Report.
- g. The system should have features to automatically track the status of various equipment at the plazas/lanes on an hourly basis.
- h. The system should have features to automatically report all the above reports to authorized representatives/IT systems in NMSCEL/MSRDC.
- i. The system should be customizable to include any of the following incidents in the reports:
 - Date / hour change
 - Hybrid lane open
 - Dedicated/FASTag Exclusive lane open
 - Lane closed
 - Invalid toll collector
 - Tariff change
 - Lane into maintenance mode
 - Lane out of maintenance mode

- Vehicle detected without collector classification (run through)
- Vehicle discrepancy
- Time exceeded for vehicle exit from lane
- Classification cancelled [for toll collector, lane]
- Vehicle reclassified
- Extra receipt printed
- TLC enclosure opened [sound buzzer]
- TLC enclosure closed
- Low disk space warning on TLC
- Low disk space warning on TMS related server
- Low disk space warning on local drive
- Insufficient memory warning on TMS related server
- Loss of communication with TMS lane system (specific TLC/AVCC)
- Communication with TMS lane system re-established specific TLC/AVCC)
- Loss Communication with specific TMS backend server
- Communication with TMS lane system re-established
- Change of TLC mode without permission
- Equipment failure: Sensor 1
- Equipment failure: Sensor 2
- Equipment failure: exit barrier
- Equipment failure: AVCC
- Equipment failure: etc. for all equipment
- Database corrupt [all database]
- Toll collector confirmed bleed-off
- Vehicle without valid FASTag detected in the toll lane
- Panic alarm initiated
- Shift opened
- Shift closed
- Change in toll collector database
- Change in user access level
- FASTag unreadable
- FASTag in Exception List
- Failure reading tariff table
- Toll collector login
- Toll collector logout
- Run through violation
- Class discrepancy – Over-classification.

- Class discrepancy – Under-classification.
- Pass back of any vehicle (any vehicle passing through the Toll plaza in the same direction within a pre-defined time period).

In addition to the above, NMSCEL/ MSRDC can design/ make any activity to be an incident in the TMS and get its status/reports.

30.1.22 **Other Features.**

The System should have following other features:

- i. Performance monitoring.
- ii. TMS Administration.
 - a. User Management
 - b. Shift Consolidation
 - c. Day Consolidation
 - d. Data Reconciliation User Interface
- iii. Maintenance Tool.
- iv. Data security and Data integrity (Lane level & TMS Level).
- v. Axle weight measurement.