a) Smart card – Touch and go: The user performs a normal payment at both plazas.

b) Cash and post payment: The system splits the payment into a payment for the first plaza and a purchase for the next plaza. When the electronic tag (bullet) is deposited at the next plaza it shall be registered as a payment at that plaza. On deposit the contents of the bullet will be erased rendering it unacceptable as a MOP.

c) Credit granted: A normal credit granted transaction would be processed at each plaza.

d) Violations: A normal credit granted transaction would be processed at each plaza.

3) At the end of the shift the collector cash-up the electronic tags (bullets) as follows:

e) First plaza – The system splits the bullet transactions from the cash transactions for accounting purposes. The collector shall cash-up the cash without reference to bullets.

f) Second plaza – The electronic tags (bullets) does not impact on the collector cash-up. The system automatically reports the received tags and reconciles them with trips at the fire plaza. Exception reports shall be available to reconcile and identify problems and fraud.

4) Fault mode. Various equipment problems may impact on the above methodology:

Tag (Bullet) issuing. In case of equipment failure cash and post payment is required at both plazas.

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1.8.3 Manual lanes

An Overhead Lane Signs (OHLS) installed on the leading edge of the canopy over the toll lanes indicate to the User which lanes are open by displaying either a red cross or green arrow.

A Traffic Light (TL) located in the manual lane is red by default to indicate that the User must stop at the tollbooth.

The toll collector inside the tollbooth visually classifies the vehicle as it approaches and enters the vehicle's classification into the toll lane computer (TLC) by pressing the appropriate classification key on the Toll collector’s terminal (RCT). The correct toll fare is calculated based on the toll collector’s vehicle class choice and the applicable toll tariff. A key to "cancel" a classification incorrectly entered into the (TCT), is available. Use of this key is reported and recorded on the Central Computer System (CCS) incident record. The toll collector shall also be allowed to cancel a transaction. This course of action triggers a timer that delays the following transaction. The period of delay is a settable parameter.

The applicable toll tariffs and blacklisted credit card list is available on the (TLC) at all times.

The toll collector's display in front of the toll collector as well as the user fare display (UFD), installed in full view of the User indicates the vehicle class and applicable toll tariff. Once the User has tendered the toll due, the toll collector accepts the fare and validates the transaction by pressing the button indicating the (MOP) received. If the collector is processing users' vehicles that are proceeding to another plaza, where the toll strategy determines that payment is due at this plaza, the user...
pays the fare for both plazas and shall be issued with a tag that shall be used as a (MOP) at the following plaza.

If the User has already passed through at a previous plaza that grants him credit at this plaza, he drops the tag (received at the previous plaza on payment) into a collector bin that reads the information and validate the payment. The traffic light change to green and the user may proceed through the plaza.

In the case of smart cards, the user (or collector) validates payment by touching a valid smart card against the reader installed in the lane. If the card is unreadable, the card number may be entered manually into the (TLC) by pressing the manual card entry key and keying in the number via the numeric keypad. In the case of smart cards that are not registered on the system (bulk passage cards) the card shall be retained and the user directed to the plaza building where the card is replaced. The remaining balance is established by checking the previous use of the card (including the last transaction) and a new card issued with the same remaining balance.

Smart card users pay at all the plazas; no tags are issued for payment at subsequent plazas.

The user fare display (UFD) indicates the acceptance of the method of payment, the traffic light turn to green and the exit barrier automatically opens. If the User requests a receipt, the toll collector shall be able to issue a receipt, printed on the receipt printer (RP), by pressing the "receipt" key on the (TLC). Receipts shall numbered sequentially for audit purposes and duplicate receipts indicate "copy" at the top of the receipt.

Once the vehicle successfully passes through the pay axis, the traffic light turn to red to allow entry of the next vehicle.
As the vehicle proceeds out of the lane, it crosses the automatic vehicle classification (AVC) system, which automatically classifies the vehicle according to the defined vehicle classes. The exit barrier then automatically close.

The Toll Lane Computer (TLC) compares the (AVC) classification to the toll collector’s classification, and if different, send a class discrepancy trigger the incident recording system utilizing a closed circuit television (CCTV) camera situated in the lane. The camera record a digital image of the vehicle together with details of the class discrepancy message and corresponding transaction number for verification by the toll supervision personnel, thereby completing the transaction.

The vehicle class recorded by the system for use on all (TMS) reporting to the toll collector classification. Hence:

If the toll collector class is greater than the (AVC) class, then collector over classification results. (No financial implication as money reported is equal to or greater than that which the toll collector is having collected from the User). This assumes that a higher class means a higher tariff.

If the collector class is less than the (AVC) class, then a collector under classification result. (This may have financial implications as the collector could have under charged for the passage). The digital image will be utilized by the supervisor to verify the proper classification. If there was a genuine under classification, the collector is charged for the difference between the tariffs of the two classes. If the digital image record of the incident verifies that the toll collector classification was correct, the discrepancy shall be “exempt” in the system.

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The completed passage across the (AVC) system indicates the end of the transaction to the (TLC). The system is in a ready state for the next transaction. The system accepts the collector classification of the next vehicle to be processed only after completion of the MOP of the current transaction. The TLC queues the transactions and allocate the correct AVC class. A unique sequential transaction number is allocated to each transaction.

1.9 OTHER PAYMENT PROCESSES

1.9.1 Credit granted Process

The toll collector press the Credit Granted key when such is being used as the (MOP). The toll collector's display (TCD) indicate (in menu format) a list of authorities that are granted credit, from which the toll collector select an authority. The toll collector then be prompted to enter the vehicle identification applicable to that authority. If the vehicle is registered in the credit granted database, a transaction record with the relevant authority's information is automatically be printed for the toll collector's records.

If the vehicle has not been registered in the credit granted database, the (TCD) returns to the initial authority list, which includes a menu item for Manual Voucher. An invoice (voucher) is written out by the toll collector for input at cash-up. A transaction record automatically be printed once the Manual Voucher item is selected.

The toll collector any stage be cancel the credit granted process and select another (MOP).

A digital image is taken of all vehicles that are granted credit, utilizing the incident recording system and report the incident to the Incident Computer

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1.10 **EXEMPT PASSAGE PROCESS**

The toll collector press the Exempt Passage key when such is being used as the (MOP). The toll collector's display (TCD) indicate (in menu format) a list of authorities that are granted exempt passage, from which the toll collector shall select an authority. The toll collector then be prompted to enter the vehicle identification applicable to that authority. If the vehicle is registered in the exempt passage database, a receipt with the relevant authority's information shall automatically be printed for the toll collector's records.

If the vehicle has not been registered in the exempt passage database, the (TCD) returns to the initial authority list, which shall include a menu item for "Manual Voucher". A voucher is written out by the toll collector for input at cash-up. A transaction record is automatically be printed once the Manual Voucher item is selected.

The toll collector at any stage be able to cancel the exempt passage process and select another (MOP).

A digital image is taken of all vehicles that are granted exempt passage, utilizing the incident recording system and report the incident to the IC.

1.11 **CREDITING DEBIT CARD (ETC) ACCOUNTS**

The lanes is having the facility to recharge smart card accounts. A "Credit Smart Card" key is made available for this process as indicated under paragraph 14.3.2.2 the software is designed to guide the toll collector through this process.

2. **TOLL MANAGEMENT SYSTEM (TMS) LEVEL PROCESS**

2.1 **ACCOUNT STRUCTURE**

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The user shall have the option to register an account on the system. These accounts shall provide the user with the following facilities:

1) Single balance for various identifiers. Each identifier shall be linked to a specific vehicle.

2) An opportunity to recharge the account at any recharge point i.e. lanes, plaza sales office or other sales points.

3) A consolidated month end account detailing all the transactions (per identifier), incentives granted and payments made in the account.

4) Incentive schemes offered by the Employer.

The account structure provides a formalized structure to organize the business rules that apply to the account system. These business rules are a matter of policy and shall be clearly defined. The account structure and its business rules are listed in this specification and the "conditions of use" applicable to the various incentive schemes.

2.2 ACCOUNT GROUPS

An account group defines the mixture of incentive profiles that can be linked to specific accounts.

2.3 INCENTIVE PROFILES

The incentive profiles are tools that the Employer can use to optimize attraction rates or to address political pressure and inequities introduced by the toll strategy. The following incentive profiles shall be supported by the (TMS).

- Nominal scheme – This scheme is used to accommodate users that prefer other methods of payment.

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• Local user schemes – the local user scheme is a plaza specific scheme that is used to address specific pressure groups linked to geographical or municipal areas.

• Frequent users

• Bulk purchase schemes – Bulk use schemes or bulk purchase discount. This includes coupons, corporate bulk users and month passes.

• Debit or credit accounts e.g. the trigger to hot list the account is set on a zero or negative balance.

The incentive schemes can further be subdivided into discount profiles to provide more flexibility in accommodating special users.

2.4 DISCOUNT PROFILES

2.4.1 Special qualification criteria need to be set for each profile, these include:

• User specific requirement e.g. municipal area, group affiliation etc.
• Frequency bands
• Vehicle class
• Bulk value bands

2.4.2 Account payment method

The methods of depositing money into the account are

• Cash,
• Bank guaranteed cheque,
• Debit order,
• Rolled-up credit card payment from the banks (this applies to users that register credit/bank fleet cards as the identifier) and
• Credit card

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2.4.3 Identifiers

Identifiers are used to link passages to an account. Each identifier needs to be linked to specific vehicle to eliminate the abuse of the incentive schemes by exchanging identifiers between users. The possible identifiers are:

- ISO Bank credit or fleet cards
- ISO cards issued by the Operator
- Smart cards
- (ETC) tags
- Coupons or vouchers

Each identifier shall be linked to vehicle with a specific class. In the case of Bank credit cards a single card may be linked to various vehicles.

2.4.4 Account registration

2.4.4.1 On registering an account the user shall be required to:

1) Complete the required forms and supply the backing documentation e.g. identification, registration and/or proof of residence documents.

2) As part of the application the road user shall indicate his billing and account delivery preferences. This shall include:
   a) No account required.
   b) Postal delivery.
   c) E-mail account details. A possibility that may be considered is allowing internet access to account details.

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3) Acceptance of the application;
   
a) The user shall pay for the identifier and pay the administration fee.
b) Pay the minimum account deposit per identifier (Debit accounts only).
c) Collect the identifier. In case of the (ETC) tags he shall be required to 
   arrange the installation with an approved dealer.

2.4.4.2 Each account is:
   
a) Assigned to an account group with its respective incentive and subsequent 
   discount profiles.
b) Register the account payment details, if an account debit procedure is 
   used.
c) Link the required number of Identifiers and vehicles to the account.
d) Record all the user information contained in the application form.

2.5 Account business rule enforcement

The system includes functionality to enforce various account business rules. 
These are:

2.5.1 Identifiers linked to a specific vehicle. The parameters to 
   enforce are:

a) Vehicle class: This will be based on collector class in manual lanes. With 
   smart card (ETC) payment, post enforcement will be used to correct usage 
   with incorrect vehicles.

b) Vehicle registration: the system allows for manual input of the vehicle 
   registration. The option to interface with an automatic number plate 
   recognition system shall be available.

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2.5.2 Pass black: The system includes a "pass back" timer that stops users from processing multiple vehicles in the same lane.

2.5.3 Low balance: in the case of smart card identifiers, the system includes an auto recharge facility. This facility triggers a request for funds to the main account. The requested funds are transferred to the specific identifier if funds are available. The recharging of the main account will trigger an automatic recharge from the Bank if funds are low.

2.6 DBIT CARDS

The system supports read/write debit cards (utilizing smart card technology). These cards carry the balance and discount information on the card. The TMS includes the functionality to generate account type information for reconciliation and card balance checking purposes. All debit card transactions are processed on actual value (no post calculation) at lane level. This includes nominal, concession and discount tariffs.

3. TOLL MANAGEMENT SYSTEM (TMS) SUMMARY

The Toll Management system (TMS) is responsible for processing the data received by the CCS into information that is to be used to verify toll transactions, provide toll collector control and performance facilities, and contains a host of management tools and reports for the effective administration of the toll operation. The TMS also assists in auditing the toll collection operation.

3.1 Central Computer System Level

The CCS at plaza level collects the lane data and provides supervision and cash-up functions. The CCS functions are:

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3.2 **Operational functions:**
- Incident management,
- Data validation,
- Traffic control,
- Import lane data and export to TMS level
- Reports.

3.3 **Financial functions:**
- Cash-up,
- Shift audit,
- Le., B. Bleed-off,
- Sundry payments,
- No-payment control,
- Voucher control
- Reports.

3.4 **Operating environment control:**
- Lane operating parameters,
- Export parameters to disk,
- Import control/ops cantor parameters,
- Reports.

3.5 **System administration:**
- TMS set-up
- Users,
- Archive and delete data,
- Backup of system
- Database administration functions,
- Reports,
- Maintenance functions

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3.6 The CCS level also assists the operational staff with their tasks, including:

3.6.1 Collector task:
   - Declare revenue collected and account for shortages and discrepancies;

3.6.2 Supervisor function:
   - Manning the control room and supervising toll activities, and collector;
   - Management of incident;
   - Ensure data completeness and correctness;
   - Manage problems with processing;

3.6.3 Plaza Manager functions
   - Daily routine tasks. Some of these tasks may be delegated.
   - Verify shifty status;
   - Control exempt passages;

3.6.4 Backup
3.6.5 Archiving
3.6.6 Weekly tasks
3.6.7 Maintenance staff
3.6.8 Breakdown maintenance;
3.6.9 Routine maintenance;
3.6.10 Calibration and equipment performance measurement;

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3.6.11 Head office tasks
   - Revenue control;
   - Fraud detection and control;
   - Optimize operational procedures;
   - Ensure that service levels are maintained;
   - Audit

3.7 TMS Centre level:

The TMS level collects the CCS Data. The functions at this level are:

3.7.1 Operational functions:
   - Manage Staff performance
   - Import CCS data
   - Check consistency and validity of CCS Data
   - Manual Mode Data
   - Export reports to Spreadsheets and other MS Office applications
   - Reports.

3.7.2 Financial function:
   - Manage Credit and other card transactions,
   - Manage E-Id (ETC) Transactions
   - Income Reports,
   - Revenue Reports.

3.7.3 Operating environment control:
   - Export parameters to disk,
   - Reports,

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3.7.4 System administration:
   - Users,
   - Archive and delete data,
   - Backup functions
   - Database administration functions,
   - Reports.

3.7.5 Maintenance functions
   - (AVC) accuracy,
   - Hardware failures,
   - Downtime
   - Availability reporting

3.7.6 Interfaces
   - CCS level
   - Accounting package (unless built in),
   - LSDU
   - IC

3.8 The TMS level assists the operational staff with their tasks, including:

3.8.1 Supervisor function:
   - Consolidate shift information;
   - Sales of cards, tags etc (if applicable) and handling public queries;
   - Banking of collected revenue;
   - Monitoring of equipment status and reporting it to the maintenance section;
   - Ensure data completeness and correctness;
   - Manage lane manning levels;

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4. SPECIFICATIONS FOR TOLL COLLECTION SYSTEM / EQUIPMENTS ON N.H.4 TOLL PLAZAS

4.1 GENERAL

The Contractor shall provide computerized automatic toll collection system at his own cost at all the four locations on N.H.4 namely:

(i) Shil phata
(ii) Shedung II
(iii) Kusgaon II
(iv) Dehu road

The Contractor shall provide the system 180 days before start of toll on NH4. The system should be able to interface to the existing system installed at Mumbai-Pune Expressway in a way that MSRDC should be able to merge data from both systems at a central computer level.

The toll collection system for N.H.4 shall be such that it is compatible with the existing system of MPEW and it shall be possible to integrate both the system. The toll collection system of N.H.4 shall be equivalent or superior to that of MPEW.

Similar toll collection system will have to be provided by the Contractor if additional exit/entries are provided on MPEW or N.H.4 and the toll collection on this additional points is assigned to the Contractor.

The intended toll system for Mumbai-Pune N.H.-4 system should have the following main features:

A fully auditable Toll System consisting the following major sub-systems:

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4.2 Toll Management Information System (TMIS)

4.3 Toll Collection Equipment.

4.2 Toll Management Information System (TMIS):
The TMIS must have the following features.

4.2.1 An integrated solution for the software with same DBMS software for both lane equipment and Management Information System.

4.2.2. Object oriented software methodology to be used.

4.2.3. Highly configurable system to ensure different languages, time of day tariffs and accounts of multiple and customizable discount structures.

4.2.4. Comprehensive reporting to handle multiple plazas, multiples toll roads (existing Mumbai-Pune Expressway) with required consolidated reporting for management.

4.2.5. Reports to be exported on windows office applications.

4.2.6. Interfacing the system to other systems like banking institutions, even capture systems, automatic traffic counting systems and incident data systems.

4.3 Toll Collection Equipment
The toll collection equipment must have following sub systems:

4.3.1. Toll Collection Computer (industrial grade IBM compatible PC) with interfaces to TMIS and LAN with customized key boards.

4.3.2. Automatic Vehicle Classification system to be able to measure axle distances, profile and axle counts with possibility for independent data