RFP APPENDIX 1

BAIFA
BAY AREA INFRASTRUCTURE FINANCING AUTHORITY

BAIFA Express Lane Network

Toll Collection System

Scope of Work

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RFP APPENDIX 1: Attachment A

BAIFA
BAY AREA INFRASTRUCTURE FINANCING AUTHORITY

BAIFA Express Lane Network

Toll Collection System

General Scope of Work

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General Scope of Work

The Scope of Work under this Agreement includes design, development, procurement, furnishing, fabrication, testing, installation, implementation, and maintenance of a complete and fully functioning Toll Collection System (TCS). Initial work will focus on the TCS for the first phase of the Bay Area Infrastructure Financing Authority (BAIFA)-authorized Express Lane Network (ELN).

The TCS is defined as the complete, functioning, electronic toll collection system that includes all hardware, software, interface, electrical, and communications equipment; works in conjunction with the FasTrak Regional Customer Service Center (RCSC); and uses various technologies to facilitate toll collection. "TCS" may also refer to an unspecified component or subsystem of the Toll System Integrator's (TSI) technical solution that performs a function being identified in the requirements. The TCS also includes provisions for an extensive Closed-Circuit Television (CCTV) traffic monitoring system and roadside data communications.

In conjunction with the TCS effort, civil infrastructure is being provided through a design-bid-build process under separate contracts. The demarcation between the TSI and the Civil Contractor is shown in Reference 2, Diagrams, Drawings and Schematics. Through the coordination process facilitated by BAIFA, the TSI will provide input and feedback on the civil design. It is expected that the 65% PS&E for I-680 will be available upon the initial NTP for Milestone 1-1 for immediate review by the TSI.

This document, along with the attached requirements, provisions and specifications, collectively comprise the Scope of Work. Information on the organization of the Scope of Work is provided below.

1. Project Corridors

This project consists of toll system integration and maintenance services for approximately 90 miles of express lanes on the following Corridors:

- I-680 in Contra Costa County between Alcosta Road and Rudgear Road;
- I -880 in Alameda County between Marina/Lewelling Boulevard and Dixon Landing Road;
- SR-92, the San Mateo Bridge westbound approach;
- SR-84, the Dumbarton Bridge westbound approach; and
- I-80 in Solano County between Red Top Road and Air Base Parkway.

See Attachment A, Scope of Work *Reference Document 2A*, Tolling Location Details for specific quantities of Corridor elements.

2. Critical Areas of Scope

Within the fully functioning TCS, the following areas are considered critical areas of scope. These elements are the core functions of the TCS, impact design and development efforts, are complex in nature, and will require thorough testing prior to deployment on the first Corridor. This is not intended to be comprehensive, and additional details are provided in the requirements included in Attachments A-1 through A-4.

Lane Level Systems

- Vehicle detection and separation

- Vehicle processing in exception cases
- Automatic Vehicle Identification (AVI)
- Violation Enforcement System
- Variable Toll Message Signs (VTMS) operations and failure logic
- Traffic Monitoring Systems (TMS)
- Data collection and storage in local servers
- Messages between controllers and Host
- Functionalities during equipment failures
- Closed-Circuit Television (CCTV) system

System Architecture

- Requirements and assumptions regarding location of all equipment including communications within a Corridor
- Sample layout of equipment, communications, and power for type of equipment location
- Preliminary architecture for each type of Read Point
- Host architecture including physical and virtualized architecture
- Host location requirements
- System security and access control
- Data storage, access, and recovery
- Back up and Disaster Recovery/Business Continuity
- End to end data flows including both internal and external interfaces
- System administration
- Capacity
- Operations Center Integration

Host Level

- Toll rate setting including dynamic pricing algorithm
- Trip Transaction Building
- Toll rate overrides and corrections
- Financial and audit applications
- Reporting and monitoring
- User and system interfaces
- Enforcement tools
- Diagnostics

System Wide

- Automatic License Plate Recognition
- Lane Modes
- Maintenance Online Management System (MOMS)

Communications

- Communications network architecture
- Communication equipment functions and installations

- Network security, protection and access
- Network configuration
- Internet protocol (IP) addressing scheme
- Redundancy, availability, capability

3. Program Phasing

The scope includes phases shown below, all of which are included in more detail in Attachments A-1 through A-3. In general, the phases will include the following activities:

Design & Development Phase

The initial phase of work is development of the TCS, which includes the items listed below. This phase commences with Notice to Proceed (NTP). See Attachment B Schedule and Project Milestones for specific events within this phase.

- Design of the TCS hardware and software components that will be integrated and installed in the lane and at the roadside within the environmental clearance constraints. This would include items like readers, antennas, Lane Controllers and cameras;
- Provision of feedback and input on civil design (starting at the 65% Plans, Specifications, and Estimates (PS&E);
- Design and development of the TCS software that will be customized to apply toll rates through a dynamic pricing algorithm, build Trips within Zones and Corridors, display the current toll rates on variable toll message signs and alert enforcement officers using beacons;
- Development of tools, interfaces, and system functionality required to operate the ELN for traffic performance. This includes the software applications, notifications, and triggers that allow system users to actively manage certain aspects of the TCS and its subsystems; and
- Design of the communications infrastructure that will connect with the communications backhaul.

Installation, Implementation & Testing Phase

The following phase of delivering the scope is to install, integrate and test the TCS, including all of the items listed below. To an extent, this phase will repeat for each Corridor and will commence upon issuance of an NTP for each Corridor. See Attachment B Schedule and Project Milestones for specific events within this phase for each Corridor.

- Installation of the TCS from roadside, to the TCS Host, to the FasTrak Regional Customer Service Center (RCSC) interface;
- Fabrication and mounting of hardware required to install in-lane devices;
- Coordination with Civil Contractor(s);
- Installation of electrical and communications required by the TCS;
- Cutting of pavement required for installation of toll subsystems for vehicle detection;
- Management of traffic control staff and devices during installation and testing;
- Provision of documentation and training for users responsible for operating the performance of the lane through the TCS; and

- Testing of all systems and subsystems at all levels including unit and Quality Assurance (QA) testing and more formally, Factory Acceptance, Onsite First Installation, Site Acceptance and Commissioning, Zone-Based, Corridor-Based, End-to-End, and Operational Tests.

Maintenance Phase

The last phase is maintenance which commences after Operational Testing is approved for each Corridor. See Attachment B Schedule and Project Milestones for specific events within this phase for each Corridor. Maintenance includes, but is not limited to:

- Monitoring and management of activities of the TCS in its entirety. This is provided through MOMS which is integrated into the TCS to automatically and constantly manage and report on TCS performance/health;
- Responding to system issues in the appropriate amount of time, determined by criticality;
- Performance of corrective and preventive/planned maintenance of the TCS; and
- Management of traffic control for in-lane/roadside maintenance.

4. Scope of Work Requirements

1. **Attachment A-1: System Requirements** – the capabilities and functionality of the TCS
2. **Attachment A-2: Implementation Requirements** – the capabilities and responsibilities of the TSI (their people and processes) to deliver the full project scope within the specified schedule and budget
3. **Attachment A-3: Maintenance and Warranty Requirements** – the responsibilities of the TSI and the functionality of their TCS to monitor, report, and manage maintenance of the TCS
4. **Attachment A-4: Business Rules –** the rules by which BAIFA operates their ELN program and drives system design, functionality, management and operation
5. **Attachment B: Schedule and Project Milestone Dates –** the schedule for implementation organized into sets of Milestones for each project phase
6. **Attachment C: Performance Requirements and Penalties** – the pre-determined metrics for system performance and maintenance response and reporting by the TSI, including associated penalties in the event the measures are not met
7. **Reference 1: Glossary of Terms, Definitions & Acronyms** – a collection of terms and acronyms used throughout the Preliminary Scope of Work
8. **Reference 2: Schematics, Drawings and Diagrams** – a reference document for graphic depictions of project elements including system design concepts and site layouts
9. **Reference 3: Conceptual Communications Network** – a design guidance document for the development of the roadside communications network
10. **Reference 4 through Reference 6** – Civil design plans and supplemental information related to each physical Corridor
11. **Reference 7**: **Work Breakdown Structure (WBS)** – The preliminary WBS used for project programming and controls
12. **Reference 8**: **System Interface Documentation** – Information related to interfaces between the TCS and external systems

RFP APPENDIX 1: Attachment A-1

BAIFA
BAY AREA INFRASTRUCTURE FINANCING AUTHORITY

BAIFA Express Lane Network

Toll Collection System

System Requirements

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Introduction

This System Requirements document contains the detailed specifications for the electronic toll collection system (TCS) to be provided by the Toll System Integrator (TSI).

The System Requirements laid out within this document define the technical means of achieving the Bay Area Infrastructure Financing Authority's (BAIFA) Express Lane Network (ELN) Business Rules, Attachment A-4.

Key Concepts and Constraints

The following section describes the key operational concepts and constraints of BAIFA's Express Lane Network at a high level. This section serves also serves as context for the system requirements provided in the remainder of this document.

BAIFA's ELN will include multiple Corridors in the San Francisco Bay Area, and will connect with existing toll bridges and express lane (EL) facilities owned and operated by other agencies. Some express lane Corridors will be deployed as part of this project phase, with additional Corridors being added under future phases and projects and incorporated into the operational Express Lane Network. Corridors deployed in this project phase may merge into longer Corridors as facilities are added, or as ownership or operational responsibilities change, so the system configuration must be flexible enough to support such scenarios. Straight-line diagrams (SLDs) depicting placement of tolling equipment along each express lane Corridor and Tolling Equipment Location Tables are included in *Reference 2*, Diagrams, Drawings and Schematics.

BAIFA's express lanes will offer a combination of restricted and continuous access between the express lane and adjacent general purpose (GP) lane. The goal of the access configuration is to preserve the flexibility inherent in the design of the existing continuous access High Occupancy Vehicle (HOV) system to the extent possible, while at the same time addressing safety and operational considerations. As a result, the configuration will be continuous access - without any solid striping, double-white striping or physical barriers - in most locations. In some Corridors, access will be limited by double-white striping in a few locations; these locations are being determined through traffic and safety analyses in the project approval, environmental document and civil design process. Continuous access enables drivers to enter the express lanes at will; therefore toll rate information needs to be displayed to drivers frequently along the Corridor. In addition, tolling equipment also needs to be closely spaced along the roadway to reduce the likelihood drivers will avoid detection.

Envisioned System Functionality

As currently defined, the basic TCS for the BAIFA ELN will function as described in the following paragraphs and as illustrated in Figure 1 below:

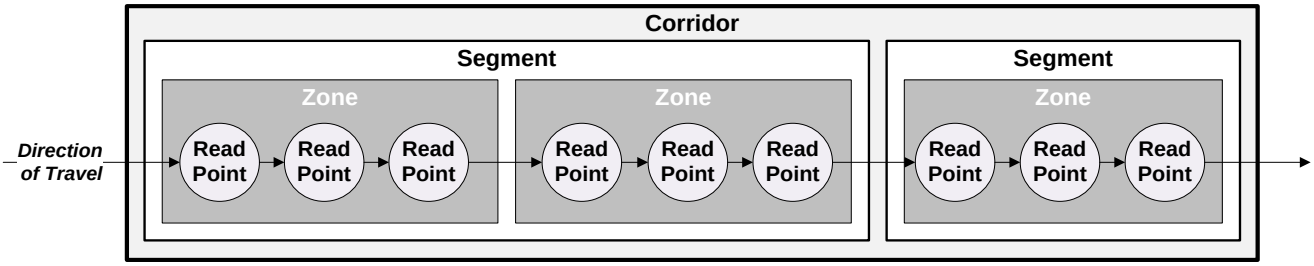
Read Points: Vehicles passing through any express lane will be identified at a series of tolling points, referred to throughout these documents as Read Points. Lane Transactions will be created at this level, from the data and images captured at the Read Point. Read Points are typically spaced about 1 to 1.5mile apart.

Zones: A Zone will typically consist of three to five consecutive Read Points in the same direction of travel. The TCS sets a single toll rate for each Zone. No matter how many Read Points a vehicle crosses within a Zone, the TCS will charge the vehicle a single toll rate for the Zone. Because the system will use Dynamic Pricing, the TCS will price each Zone separately, based on traffic in the area, displaying the current rate simultaneously on multiple Variable Toll Message Signs (VTMS) within the Zone.

Segments: A Segment will consist of several consecutive Zones in the same direction of travel and will typically end at a major destination. The TCS will use Segments in assigning toll rates to vehicles as explained below.

Corridors: A Corridor will consist of several Segments and will extend the length of an individually named / numbered highway that is managed by a single agency or authority. For example, the portion of I-680 managed by BAIFA would comprise one Corridor, while BAIFA's section of I-880 would form another.

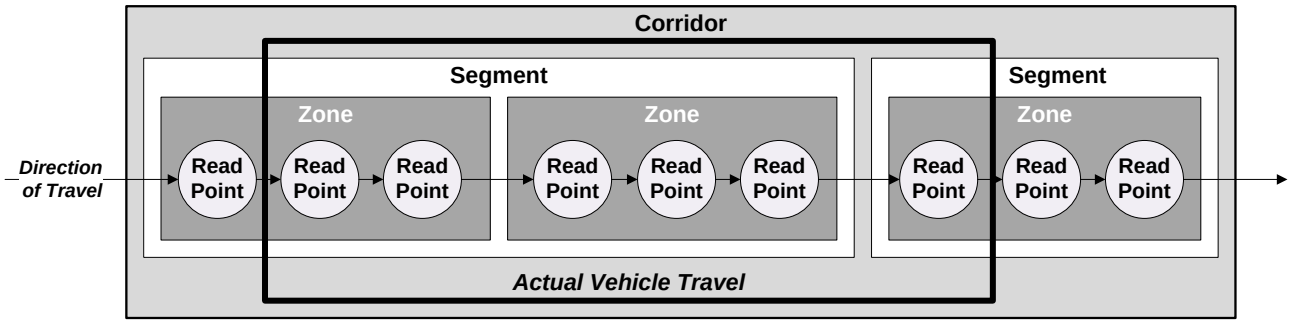
Figure 1: System Functional Structure



A set of Segments, Zones, and Read Points will be defined and uniquely identified for each direction of travel within a Corridor. However, Corridors will be the same for both directions of travel. For example, BAIFA's portion of I-880 is a Corridor, including the lanes traveling both northbound and southbound.

Applying these concepts to actual customer travel in the express lanes themselves, Figure 2 below illustrates a portion of a Corridor consisting of portions of two Segments. A vehicle enters the express lane Corridor before the second Read Point of a Zone (part way through a Segment), travels through another Zone in that Segment, and then exits the express lane Corridor after crossing a Read Point in the next Zone/Segment.

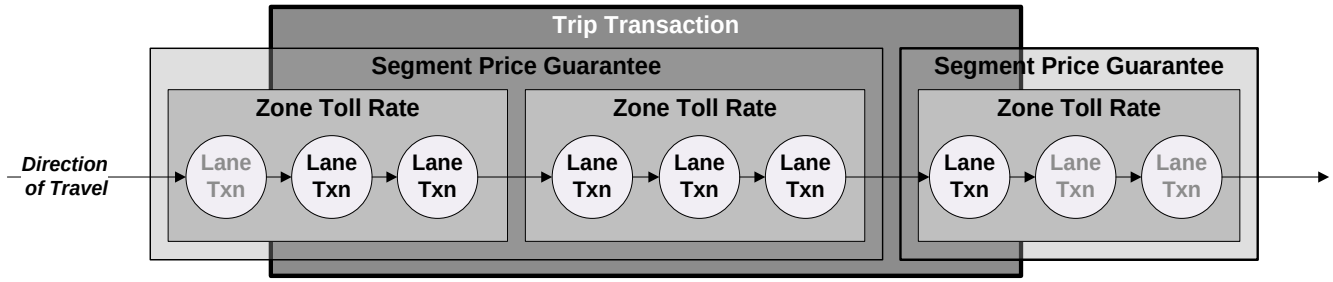
Figure 2: Actual Vehicle Travel



Lane Transactions and Trip Transactions: At each Read Point, the TCS will generate Lane Transactions that are based on transponder read, vehicle image, and/or license plate number. The TCS will combine these Lane Transactions associated with the same vehicle based on matching transponder numbers, vehicle images, and/or license plate numbers into a single Trip Transaction, in the process called Trip Building. The Trip Transaction can include all transponder Lane Transactions, all license plate number Lane Transactions, or a combination of Lane Transactions under certain conditions. The TCS will not rely on the RCSC for image review for Trip Building. The TCS will create separate Trip Transactions for each Corridor. The TCS will combine the toll rates for each Zone a vehicle passes through into a single toll rate for the Trip Transaction.

Figure 3 below shows that the TCS will combine the Lane Transactions, which resulted from the vehicle travel depicted in Figure 2, into a single Trip Transaction. In Figure 3, Lane Transaction has been abbreviated as Lane Txn.

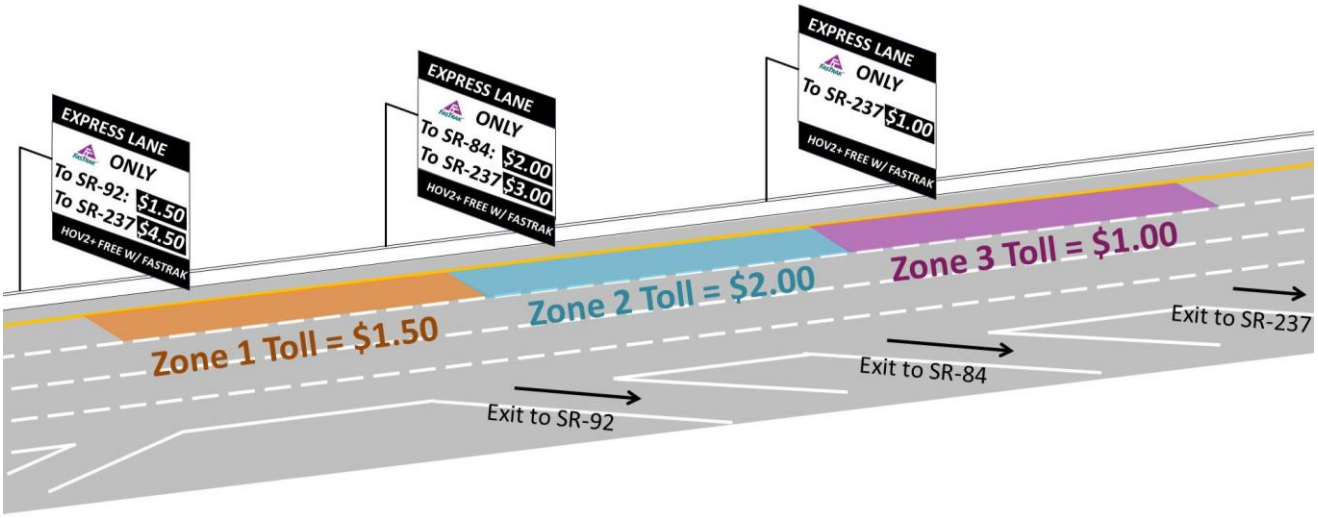
Figure 3: Defined Trip Transaction



Signage and Pricing

Multiple VTMS will be located along the Corridor and in each Zone to inform drivers of toll rates if they choose to enter the express lanes. Each VTMS will display the current toll rate for travel in that Zone on the top line of the sign. The VTMS will also display the toll rate for travel along the whole Segment (i.e., to the next major destination) on the second line from the top. The TCS will calculate the Segment toll rate by combining the current Zone toll rates for all of the Zones between the VTMS and the end of the Segment. Note that all VTMS within the same Zone will display the same toll rate(s). Figure 4 below depicts a representative set of VTMS for each Zone showing the toll rates along a Segment. Toll rates will be assigned to the vehicle by Zone and will be based on the prices the driver would have seen on the last VTMS they passed before entering each Segment. The TCS will determine the VTMS viewed by the driver based on associating Read Points to VTMS. Read Points will be associated with VTMS located either directly upstream or the VTMS where they are co-located on the same sign structure. BAIFA policy discussions dictate that these toll rates would be guaranteed, "locked in," for the Zone and Segment from the point where the driver first sees them. There will also be a VTMS general message line at the bottom of each sign that will allow for messages other than toll rates to be displayed.

Figure 4: Example of the Variable Toll Message Signs



Other Toll Facilities

The SR 237 Express Lanes (Santa Clara Valley Transportation Authority (VTA) owned and operated), existing I-680 Express Lanes (Joint Powers Authority/Alameda owned and operated), Bay Area Toll Authority (BATA) bridges, and the Golden Gate Bridge are not part of BAIFA's Express Lane Network, and are not included as part of this procurement. In the event one of these facilities connects to the various potential BAIFA express lane facilities, they will not be included in a BAIFA Trip Transaction.

For the purposes of BAIFA's express lanes, a Trip Transaction will be created for each Corridor traveled. A Corridor will typically be defined as the length of a named or numbered highway (e.g., I-680). However, sometimes a Corridor will be the portion of a single named / numbered highway that is managed by a single tolling agency. For example, the portion of I-880 that includes BAIFA-managed express lanes will be a separate Corridor from VTA's express lanes on SR 237 even though one flows directly into the other.

This concept would also apply to the seven BATA bridges. BAIFA's ELN will include bridge approach segments on SR 84, leading to the Dumbarton Bridge toll plaza, and on SR 92, leading to the San Mateo Bridge toll plaza. Bridge tolls will remain distinctly separate from the express lane tolls charged, with independent data, images, customer transactions, and revenue.

Switchable Transponders

All vehicles wanting to use the BAIFA express lanes will be required to have a FasTrak transponder. There will be FasTrak Switchable Transponders available that will allow drivers to declare their carpool status in order to be eligible for a HOV Discount. These Switchable Transponders will allow the vehicle's driver to set their status for a given trip to HOV 2 or HOV 3+, when carrying a qualifying number of occupants, or to single occupancy vehicle (SOV) when traveling alone. A Switchable Transponder set in SOV status will be handled the same as a vehicle with a standard non-switchable FasTrak transponder and charged the full toll rate.

Currently available Switchable Transponders use either a slide or switch mechanism, keeping driver distraction for this purpose to a minimum. It is anticipated that Switchable Transponders will be in use on other Express Lane facilities in the Bay Area in the foreseeable future, most likely prior to the opening of the first of BAIFA's express lane facilities. While it is yet to be determined which Switchable Transponders will be procured in a separate contract by BATA for use in the Bay Area, the selected Switchable Transponder will be required to comply with State of California statutes related to protocols and interoperability.

Enforcement

BAIFA's TCS will be required to identify vehicles declaring HOV status by using the Switchable Transponder setting to determine eligibility for various HOV toll Discounts. When a Read Point detects a vehicle with a transponder set to the predetermined HOV setting, it will light roadside occupancy enforcement beacons at that Read Point. This will indicate the vehicle's declared HOV status to law enforcement and allow law enforcement to make informed decisions about which vehicles to pursue. Vehicles without any transponder will be automatically detected by the TCS and have their license plates captured by the TCS' Violation Enforcement System (VES) cameras. Vehicles without transponders will be assessed the SOV toll rate, therefore law enforcement would not pursue such vehicles for occupancy enforcement.

System Architecture

In support of this system functionality, BAIFA has envisioned a TCS comprised of the following parts, depicted in Figure 5:

Lane: Read Points will connect to roadside Lane Controllers that manage all in-lane Read Point components. Data and images captured by in-lane components will be routed to the Lane Controller, which packages them into Lane Transactions for transmission to the Host.

Host: Lane controllers will communicate with the Host, which is the central collection point and processing unit of the TCS. The Host will also connect with other tolling equipment deployed in the field in order to set and display toll rates dynamically. In addition, the Host will perform Trip Building functions, including:

- Matching Lane Transactions by transponder number, vehicle image, and/or license plate number
- Identifying Zones traversed
- Determining prices for each Zone based on traffic information and associating the correct toll with a Trip Transaction
- Creating Trip Transactions

The intention is for the Host to centrally transmit Trip Transactions and associated images to the existing Regional Customer Service Center (RCSC) for customer account posting. The Host will also be the interface with other external systems, such as Caltrans' California Freeway Performance Measurement System (PeMS) and Traffic Management Center (TMC), and MTC's 511 system. Corridor-level or sub Hosts may be used to aggregate information to the Host.

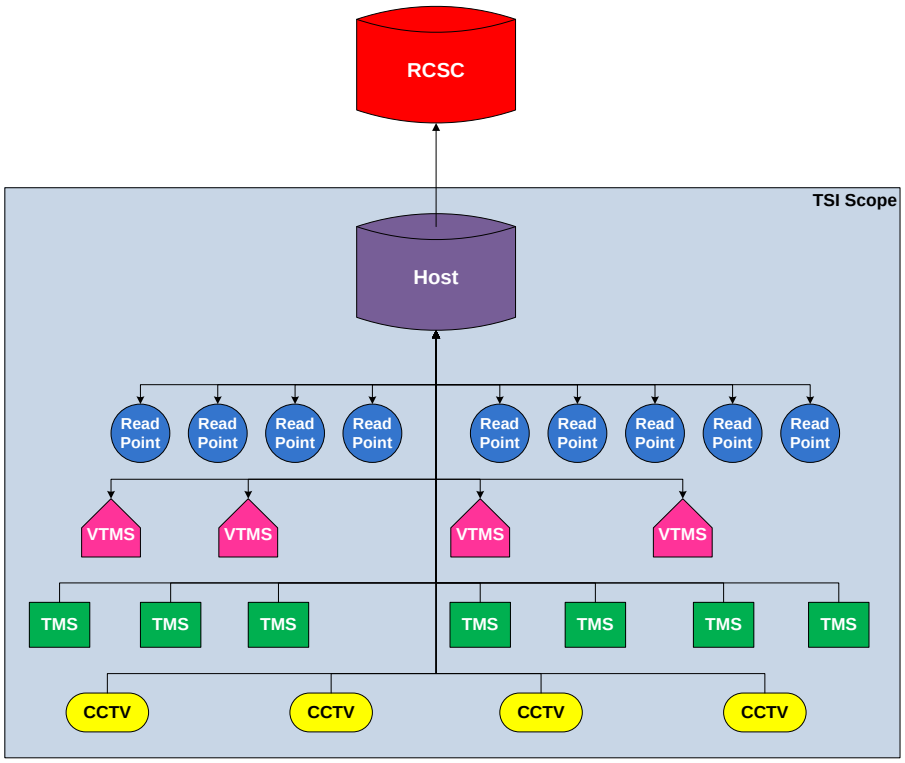
VTMS: VTMS will display the toll rates sent to them by the Host. VTMS will communicate through the associated Sign Controller directly back to the Host.

TMS: Traffic Management System sites will capture traffic data for use in Dynamic Pricing and other congestion management functions. Data captured by TMS devices will be routed directly back to the Host for storage, management, utilization, and sharing with other stakeholders.

CCTV: Closed-circuit television (CCTV) sites will use pan/tilt/zoom cameras to provide visibility into traffic conditions along each Corridor, as well as confirm VTMS displays. CCTV streaming video will be routed to the Host for use by the express lane Toll Roadway Operations Center and others, as needed.

Automatic License Plate Recognition (ALPR) is required; however, it will be up to the TSI to propose an ALPR solution located at the Lane or Host, taking into consideration technical feasibility, communication bandwidth, cost, etc. The ALPR will be used as part of the Violation Enforcement System (VES) and trip building as needed. The TCS's Digital Video Audit System (DVAS) will be used to for lane performance auditing purposes and may use either the VES cameras or supplemental cameras connected to the lane equipment or the Host.

Figure 5: Basic System Architecture



Network Communications

The ELN overall system communications network described herein shall leverage existing California Department of Transportation (Caltrans), Bay Area Rapid Transit (BART), and BATA communications infrastructure where available. BATA/BAIFA will build and make available a regional distribution network that shall provide a communications path to a variety of projects and the existing BATA network using a local area network, fiber optic cables and/or leased line infrastructure. This network shall be referred to as the "Backhaul Network." The Backhaul Network is expected to be implemented before the TSI begins testing of their express

lane network communications from the roadside to the Host. Backhaul network locations that provide and concentrate network connections along the corridor are referred herein as Backhaul Hubs.

The "Roadside Network" is the responsibility of the TSI and provides communications and network services to Toll Collection System sites along the Corridor. It touches the in-lane toll collection system devices for local communications and the Backhaul Network. At primary and secondary "Host" sites, communications will need to support data center needs, interface to external systems, and to the Backhaul Network. Communications equipment will also be needed at the primary and secondary "Toll Roadway Operations Center" sites in order to support tolling roadway operations. The TSI is responsible to furnish, install and configure equipment at the Toll Roadway Operations Centers.

System Requirements

1. General Requirements

General requirements applicable to the entire Scope of Work:

1.1 Bay Area Physical Environment

1.1.1 TSI shall be responsible for assessing the unique environment of each Corridor and locations where equipment will be installed by the TSI. The TSI shall design the TCS to meet performance requirements under all local conditions.

1.1.2 The TSI shall provide a TCS solution that complies with civil infrastructure proposed in the RFP. Modifications to the civil design are subject to BAIFA and Caltrans design approval.

1.2 Scalability & Flexibility

1.2.1 TSI shall develop a scalable and flexible TCS that can be expanded as more express lane Corridors become operational.

1.3 Hardware

1.3.1 The TCS shall be designed to operate without degradation of performance in the humid and corrosive environment typical of the San Francisco Bay Area. Lane equipment and enclosures shall be protected from corrosion, especially electrical connectors which must be removed and reconnected during preventative or remedial maintenance.

1.3.2 All equipment supplied by the TSI shall operate in the electromagnetic environment present on the ELN without any errors or degradations due to electromagnetic interference (EMI) or interference to the surrounding environment.

1.3.3 The TSI shall secure copper conductors and aluminum to protect from theft or vandalism. Theft insurance policies shall be permitted, but do not relieve the TSI from

maintaining the system integrity and achieving the Performance Measures. The TSI shall provide the security measures to deter and/or prevent such theft or vandalism, with devices and active security measures such as , but not limited to:

1.3.3.1 Tamper resistant hardware

1.3.3.2 Active monitoring devices

1.3.3.3 Embossed or engraved material with identification of property owned by BAIFA

1.3.4 Hardware shall be designed with the following specifications:

1.3.4.1 All components that perform the same function shall be interchangeable.

1.3.4.2 Replacement parts and units shall be modular such that each can be changed without equipment modification required to any part of the TCS.

1.3.4.3 All electronic components shall be installed in non-corrosive sealed enclosures and meet the requirements specified in this Scope of Work.

1.3.4.4 International Organization for Standardization (ISO) standard input/output interface modules shall be used in the design and all serial, discrete and network interface boards shall have at minimum two spare slots to support the addition of components.

1.3.4.5 All field wiring shall be terminated on screw lugs or connectors and all connectors shall be keyed or polarized to prevent incorrect connections.

1.3.4.6 All wiring and connectors shall be labeled per industry standards and codes referenced below in Section 1.5.

1.3.4.7 Surge suppression shall be provided for all field wiring susceptible to lightning or surges.

1.3.4.8 All lane equipment shall be fused or circuit breaker protected against over current, over voltage, under voltage and lightning.

1.3.4.9 Power supplies shall be provided for all required internal DC voltages.

1.3.4.10 All equipment shall be properly grounded to ensure the safety of maintenance personnel.

1.3.4.11 All Read Points shall use identical components for each part of the system eliminating the need for multiple sets of spare parts and repair procedures. Substitutions of components shall conform to the RFP and Performance Requirements and be approved by BAIFA.

1.3.5 Tolling equipment deployed on the roadside shall be secure and protected from traffic.

1.4 Applicable Codes & Standards

1.4.1 All work by the TSI when designing, installing and maintaining equipment shall be in conformity with the current adopted requirements of the following:

- State of California Department of Transportation Standard Specifications and Standard Plans;
- National Electric Code;
- National Electric Safety Code;
- Occupational Safety and Health Administration (OSHA);
- National Electrical Manufacturers Association (NEMA);
- Institute of Electrical and Electronic Engineers (IEEE);
- International Standards Organization (ISO);
- Federal Highways Administration's (FHWA) Manual on Uniform Traffic Control Devices (MUTCD);
- Federal Communications Commission (FCC);
- Telecommunications Industry Association (TIA)/ Electronic Industries Association (EIA) Standards
- Internet Engineering Task Force's (IETF) Request for Comments (RFC)

1.4.2 The TCS shall be fully compliant with Title 21 of the California Code of Regulations which establishes the technical requirements for Electronic Toll Collection (ETC) readers and transponders used in the State of California. The TSI shall supply equipment in compliance with this regulation and shall ensure that the system implementation provides transponder-reader level compatibility with other members represented through the California Toll Operators Committee (CTOC).

1.5 Unique Identifiers

1.5.1 The TCS shall assign a unique identifier to each file, transaction, alarm, incident, or other type of information communicated between parts of the TCS or through an external interface (e.g., Lane Controller to Host and Host to RCSC).

1.5.2 These unique identifiers shall increment so that like events that follow each other chronologically shall have consecutive identifiers.

1.5.3 The TCS shall have the ability to detect and report on any gaps in unique identification numbers so that the TCS can report on missing transactions, files or incident reports.

1.6 Roadside Equipment Enclosures

1.6.1 The TSI shall specify, furnish and install Lane Controller cabinets onto foundations or mounting surfaces to be provided by the Civil Contractor in accordance with TSI requirements provided to the Civil Design Engineer during the civil design phase. Final

coordination shall be the responsibility of the TSI during design to ensure that the provisions by the Civil Design Engineer for the cabinets are compatible.

1.6.2 Lane Controller cabinets shall have at least 30% capacity for future expansion (rack unit U's) to accommodate added boards and components.

1.6.3 All roadside enclosures will be appropriately weatherproofed, ruggedized and NEMA certified for field use, and will include any necessary heating and cooling units to ensure proper and reliable operations in the Bay Area environment. All enclosures will provide for suitable air circulation such that internal enclosure temperature is controlled to meet the manufacturer's specifications of all equipment contained within the enclosures.

1.6.4 All roadside enclosures will be appropriately sized such that they are unobtrusive and present minimal safety risk or hazard to traffic flow as determined by Caltrans. Enclosures and locations are subject to approval by Caltrans and BAIFA.

1.7 Uninterruptable Power Supply (UPS)

1.7.1.1 The TSI shall provide UPS back up at all roadside tolling and network equipment location sufficient to maintain normal tolling operations for a minimum of three hours.

1.7.1.2 UPS shall provide alarms and health status to Maintenance Online Management System (MOMS).

2. Roadside System

The Roadside System encompasses all tolling and surveillance equipment deployed along the express lane Corridors.

2.1 Automatic Vehicle Detection and Automatic Vehicle Classification (AVD/AVC) System

2.1.1 The TSI shall select and install an AVD/AVC system at each Read Point to detect vehicles in the express lanes with the following functionalities including, but not limited to, the ability to::

2.1.1.1 Detect accurately vehicles between 0 and 100 MPH.

2.1.1.2 Separate vehicles spaced two feet or more apart. The vehicle separation equipment shall be able to detect a trailer and ensure that vehicles with a tow are reported as one single unit.

2.1.1.3 The sensors shall provide vehicle event messages and signals to the Lane Controller and may also trigger the Violation Enforcement System (VES) cameras.

2.1.1.4 If the sensors store time internally, they shall synchronize time with the Lane Controller

2.1.1.5 The sensors shall be capable of performing diagnostics and reporting health to the Lane Controller when polled or at configurable intervals.

2.1.1.6 The AVD/AVC system shall be able to classify vehicles to populate Lane Transactions. The final classification scheme shall be subject to BAIFA approval.

2.2 Automatic Vehicle Identification (AVI) subsystem

2.2.1 The TSI shall install a fully functioning AVI subsystem with all associated electronic devices required at each Read Point for communication to vehicle transponders and the Lane Controller.

2.2.2 The AVI subsystem shall include, but not be limited to, the following functionalities:

2.2.2.1 Correctly associate transponders to vehicles when the vehicles are traveling in the express lane, straddling express and general purpose lanes, or traveling in the shoulder.

2.2.2.2 Not read transponders in the general purpose lanes.

2.2.2.3 Provide all electronic interaction to the transponder and ensure that a transponder identification number is recorded only once per passage through the Read Point.

2.2.2.4 Read and buffer, at minimum 50,000 transponder reads, in the event that communication to the Lane Controller is unavailable.

2.2.2.5 Allow for removal of transponder reads from the reader via a portable data storage device for transaction processing in the event that communications cannot be restored. Transponder reads shall be automatically sent to the Lane Controller when communications are reestablished.

2.2.2.6 Detect, report, and store the time, date, and transponder number of all transponder reads at a Read Point regardless of the state of the Lane Controller computer and the Host.

2.2.3 The AVI subsystem shall have at the following multiprotocol capabilities:

2.2.3.1 The AVI shall simultaneously support at least two Dedicated Short Range Communications (DSRC) protocols.

2.2.3.2 The AVI shall support Title 21 DSRC protocol.

2.2.3.3 The AVI shall support the 6C DSRC protocol governed by ISO 18000 6C Tolling AVI Transponder Programming Standard maintained by the 6C Toll Operators Coalition. The AVI's 6C capabilities shall be certified by an approved independent third party lab and certification process under the OmniAir Certification Services' ISO 18000-6C Certification Program.

2.2.3.4 Title 21 protocol read performance shall not be degraded by the use of any second protocol.

2.2.3.5 The TSI shall meet the standard for the Dedicated Short Range Communications (DSRC) protocols and the number of DSRC protocols the proposed readers can process at the same Read Point, at the same time, in an open road tolling environment, at highway speeds.

2.2.3.6 The TSI shall successfully read properly mounted transponders between 0 MPH and 100 MPH.

2.2.3.7 The multiprotocol reader shall be able to read at least one vehicle equipped with a transponder of one DSRC protocol and read the next vehicle equipped with a transponder of another DSRC protocol in the same lane between 0 MPH and 100 MPH.

2.2.4 The AVI reader subsystem shall synchronize the time with the Lane Controller.

2.2.5 The AVI reader subsystem shall enable the Lane Controller to poll and determine the AVI reader subsystem's health at configurable intervals.

2.2.6 The TCS shall configure the ability to turn on or off the transponder "beep" functionality as determined during the design process.

2.3 License Plate Image Capture - Violation Enforcement System (VES)

2.3.1 The TSI will provide all necessary hardware and software required to support the VES in-lane requirements including, but not limited to the following:

2.3.1.1 The ability to capture two (2) images of the rear license plate (if present) of each vehicle that passes through a Read Point in the express lane under all light conditions. If a license plate is not present or human readable, the system shall capture an image of the vehicle.

2.3.1.2 The ability to capture and process images of vehicles traveling in stop and go traffic, between 0 and 100 mph, and vehicles with separation of at least 4 feet.

2.3.1.3 VES shall be able to self-trigger if necessary to detect vehicles passing through the Read Point in the event that the AVD/AVC system is unavailable.

2.3.1.4 Camera illumination devices shall be mounted such that the installation and operation of these devices does not affect driver safety in any fashion as determined by BAIFA and Caltrans.

2.3.1.5 The VES shall have the ability to synchronize its time with the Lane Controller or through the network to the same source as the Lane Controller, and shall be capable of performing diagnostics and reporting its health to the Lane Controller at any time.

2.4 Lane Controllers & Lane Transactions

2.4.1 Lane Controllers shall be provided at all Read Points for the express lane as specified in *References 4-6,* Civil Design Documents. Lane Controllers may be used on adjacent Read Points of opposite directions.

2.4.2 The Lane Controllers shall process all data obtained from the in-lane equipment and subsystems to generate a Lane Transaction for each vehicle passing through a Read Point that accurately associates captured AVI reads and VES images.

2.4.3 All Lane Transactions shall be uniquely, sequentially identified from each Lane Controller.

2.4.4 The detailed transaction processing rules and the transaction message details will be defined and finalized during the design phase; however, the following basic requirements will apply:

2.4.4.1 All transponder reads shall be processed and reported in a Lane Transaction.

2.4.4.2 The Lane Controller shall have the ability to process reads from multiple transponders in a vehicle.

2.4.4.3 One Lane Transaction shall be created for each vehicle that travels through a Read Point.

2.4.4.4 The Lane Controller shall ensure that the creation of the Lane Transaction is completed prior to transmitting it to the Host.

2.4.4.5 The Lane Controller shall be able to handle multiple vehicles near the Read Point and to track each one accurately in order to create Lane Transactions in all traffic conditions.

2.4.4.6 The Lane Controller shall be able to automatically synchronize with the various subsystems to ensure the events in the lane correspond to the Lane Transaction generated and are associated with the correct vehicle.

2.4.5 Lane Controller functionality shall include start-up procedures for initialization, and for self-diagnostics test sequences. Upon initialization, the Lane Controller shall verify with

the Host that it has the latest configuration files, application software, and any other files required to support the lane operations. If the latest files are not present on the Lane Controller, the Lane Controller shall first attempt to retrieve updated files from the Host before sending a notice to the MOMS application to alert maintenance that there may be a configuration issue.

2.4.6 The Lane Controller upon start-up shall also synchronize its time with the Host.

2.4.7 Alarm messages shall be reported for all failure and anomaly conditions and a notification of the diagnostic check completion shall be transmitted to the MOMS. Failures and anomalies shall be defined during the design phase.

2.4.8 Each Lane Controller shall have a unique Internet Protocol (IP) address that identifies its location.

2.4.9 The TSI shall furnish all equipment necessary for communications between the Lane Controller and connected subsystems.

2.4.10 The Lane Controller shall interface with the AVI subsystem. The Lane Controller will report all transponder reads as elements of the Lane Transaction; the details of the data format shall be finalized during the design phase. Loss of communication to any element of the AVI system shall be immediately detected by the Lane Controller and transmitted to the MOMS.

2.4.11 The Lane Controller shall interface with the in-lane VES subsystem to capture and process images of all vehicles passing through the express lanes in accordance with the BAIFA Business Rules. Loss of communication to any element of the VES shall be immediately detected and transmitted to the MOMS.

2.4.12 The Lane Controller shall interface with the AVD/AVC system as necessary to trigger transponder reads and VES cameras and accurately process Lane Transactions. The data format of the Lane Transaction shall accommodate the vehicle class category as detected by the AVD/AVC. Loss of communication to any element of the AVD/AVC system shall be immediately detected by the Lane Controller and transmitted to the MOMS.

2.4.13 All Lane Controllers shall be time synchronized either to the Host server as a primary source or to a common time synchronization source. The Lane Controller will synchronize or transmit time synchronization messages with every device capable of maintaining time.

2.4.14 Lane Controller equipment shall be designed in a redundant configuration where there is a single primary Lane Controller with a “hot standby” secondary Lane Controller able to take over in the event the primary unit fails (automatic failover). When the secondary unit detects that the primary is off-line, the secondary unit shall assume the functions of the primary unit without manual intervention. Alarm messages shall be

generated when such an event occurs. These alarm messages shall be automatically transmitted to the MOMS.

2.4.15 The TSI's redundancy design shall ensure that there is no loss of Lane Transactions or of revenue when one of the Lane Controllers fails. Only one Lane Controller (either the primary or secondary) at any Read Point at a time shall generate Lane Transactions. The switchover from the primary Lane Controller to the secondary Lane Controller shall be transparent to the rest of the TCS.

2.4.16 The TSI will provide an automated means of synchronizing the Lane Controller and Host in the event that any of the following events occur: (1) the Lane Controller is replaced; (2) communications are down; (3) control is switched from one of the redundant Lane Controllers to the other; or (4) when data on the Lane Controller is not retrievable due to a catastrophic failure.

2.4.17 The Lane Controller shall allow for manual exchanges of data with the Host via portable data storage devices in the event of a communication failure. This shall include but not be limited to transfer of Lane Transactions from the Lane Controller to the Host and the transfer of configuration files and Tag Status File (TSF) from the Host to the Lane Controller.

2.4.18 All configuration files and tables needed to support lane operations shall be maintained at the Host for version control and be available for download to the Lane Controllers from the Host. All Lane Controller software shall be transmitted to the Lane Controllers from the Host and versions on each Lane Controller shall be maintained, tracked and recorded.

2.4.19 The Lane Controller shall be capable of operating in a stand-alone mode if communications between the Lane Controller and Host are down. When operating in this mode, the last configuration, and application files downloaded from the Host application, shall be used while processing vehicles. Upon re-establishing communications with the Host, configuration files shall be checked and all back-logged messages shall be transmitted to the Host without affecting or degrading near real time lane operations. The Lane Controller shall be capable of storing all Lane Transaction information and all images collected while in stand-alone mode for a minimum of 30 days.

2.4.20 All messages between the Lane Controller, various components, peripherals, subsystems, and the Host shall utilize a documented, open, non-proprietary industry standard communication protocol that is made available to and approved by BAIFA during the design phase.

2.5 Roadside Enforcement

2.5.1 Occupancy Enforcement

2.5.1.1 Enforcement of proper vehicle occupancy for Discounted passage in the express lanes shall be facilitated by beacon light(s), illuminated with a color determined by BAIFA during the design phase, within 0.201 seconds of the transponder read by the AVI antenna to indicate the vehicle's transponder-based occupancy declaration, regardless of the transponder's status (i.e. low balance, valid, insufficient funds, invalid, lost/stolen).

2.5.1.2 The occupancy enforcement beacon shall illuminate once, each time the vehicle passing under the gantry is detected with a transponder read declaring sufficient occupancy for Discount passage. Illumination of the occupancy enforcement beacon lights shall be distinguishable between consecutive vehicles.

2.5.1.3 The TCS shall provide the ability to select the level of occupancy (HOV 2 or HOV 3+) needed for Discount passage for a particular Corridor and when the occupancy enforcement beacon functionality is turned on and off via an administration Graphical User Interface (GUI).

2.5.1.4 At every Read Point, up to two occupancy enforcement beacon types may be present as determined by BAIFA during the final design phase.

2.5.1.4.1 Overhead Beacon Light (OBL)

2.5.1.4.1.1 The overhead beacon light shall be a 180-degree light mounted overhead at Read Points determined by BAIFA during the design phase.

2.5.1.4.1.2 The OBL must be visible to California Highway Patrol (CHP) vehicles traveling in the same direction of travel in the express lane and the general purpose lanes and must not be a distraction to drivers as determined by BAIFA and Caltrans.

2.5.1.4.2 Observation Area Beacon Light (OABL)

2.5.1.4.2.1 At select Read Point locations with CHP observation areas, see *References 4 - 6,* Civil Design Documents, for proposed locations, a directional beacon signal head shall be mounted for visibility from the CHP observation areas and must not be a distraction to drivers as determined by BAIFA and Caltrans.

2.5.1.4.2.2 The OABL shall be installed on a height-adjustable mount for visibility calibration.

2.5.1.5 The TCS shall have the ability to support a second set of occupancy enforcement beacon light illumination sequences in order to differentiate between HOV 2 and HOV 3+ vehicles.

2.5.2 Other Enforcement Beacons

2.5.2.1 The TCS shall support the ability for an additional beacon capable of emitting a color approved by BAIFA during the design phase. The TCS shall be capable of emitting a light if a vehicle is detected with no transponder read in the lane. This beacon may support HOV-only Lane Mode enforcement and enforcement of transponder requirements that may be put into effect as Business Rules change in the future.

2.5.2.2 The TCS shall provide the ability to turn the beacon functionality on and off via an administration GUI.

2.6 Variable Toll Message Signs (VTMS)

2.6.1 VTMS shall be used to communicate express lane toll rate information to motorists via light emitting diode (LED) panels affixed to the overhead toll rate sign structures. The VTMS LED panels shall be managed by roadside VTMS controllers that will communicate with the Host to display toll rates and messages by express lane operators.

2.6.2 At each VTMS location, there shall be up to three LED panel types detailed below. See *Reference 2*, Diagrams, Drawings and Schematics, for proposed signage layouts and Section 3.9.5 for more information on toll rate publishing.

2.6.2.1 The Zone LED panel shall be 28-inches high by 10-feet wide to display Zone toll rate information.

2.6.2.2 The Segment LED panel shall be 28-inches high by 10-feet wide to display the toll rate information for passage to the end of the Segment.

2.6.2.3 The general message LED panel shall be 28-inches high by 27-feet wide to display other tolling information.

2.6.3 The TSI shall provide VTMS LED panels that can display 18-inch high characters as required by the MUTCD.

2.6.4 The VTMS LED panel shall comply with and the American Association of State Highway and Transportation Officials (AASHTO) “Standards Specifications for Structural Supports for Highway Signs, Luminaries and the section titled Dynamic Message Sign Assembly” and Caltrans requirements.

2.6.5 Each VTMS controller shall have a unique IP address that identifies its location.

2.6.6 The VTMS with associated controllers and software shall be capable of displaying MUTCD, Caltrans and BAIFA approved text, graphical images and shapes. The VTMS shall be able to display amber color at a minimum.

2.6.7 The LED panel shall include the ability for the VTMS controller to report to the Host what is being displayed by interrogating the sign pixels. The VTMS shall report to the Host what is being displayed on the LED panel at the time of every rate change, and the Host shall store the display history for reporting.

2.6.8 The LED panel shall include a light sensor to measure the ambient light and adjust the intensity of the LEDs to be visible under all light conditions.

2.6.9 The VTMS shall be capable of operating in a stand-alone mode if communications between the VTMS and Host are down.

2.6.10 Historical toll rates and messages for specified time periods that have been transmitted to the VTMS from the Host shall be used in the event of a communication outage or other conditions as determined by BAIFA during the design phase.

2.6.11 The VTMS shall have the ability to persist last toll rates for a configurable amount of time.

2.6.12 Upon re-establishing communications with the Host, the VTMS shall communicate to the Host actual toll rates and messages displayed during the communication outage.

2.6.13 The VTMS shall be capable of storing all displayed information while in stand-alone mode for a minimum of 30 days.

2.6.14 VTMS controllers shall be located in weather hardened roadside enclosures to be specified, provided, installed and integrated by the TSI.

2.6.15 The VTMS controller shall monitor its health and that of VTMS subcomponents in order to report health diagnostic information and send alert messages to MOMS.

2.6.16 The VTMS controller shall be time synchronized either to the Host server as a primary source or to a common time synchronization source.

2.7 CCTV Cameras

2.7.1 The TSI shall provide a CCTV system for the purpose of remotely viewing real time and historic video from the express lane Corridor. See *Reference 2,* Diagrams, Drawings and Schematics*,* for CCTV camera locations.

2.7.2 The CCTV system shall integrate into Caltrans' Traffic Management Center CCTV video control and distribution system, Bay Area Video Upgrade (BAVU), which uses the Cameleon Host Interface Driver.

2.7.3 CCTV cameras shall allow for the remote view of traffic conditions in the EL and GP lanes and verify toll rates messages displayed at each VTMS.

2.7.4 The TSI shall provide CCTV cameras with full color, provisions for pan, tilt and zoom (PTZ), and with optical and digital zoom. The cameras shall be capable of showing legible images of the VTMS displays in all light conditions.

2.7.5 The CCTV system shall provide preset camera PTZ location setting capabilities and the ability to exclude views (i.e. ensure that a camera cannot pan into someone's backyard).

2.7.6 The CCTV system shall include remote recording capability on demand to allow for historical viewing for up to three (3) days of streaming video and allow for viewing of historical video of up to three (3) locations on each Corridor simultaneously.

2.7.7 All externally mounted or installed components of the CCTV system (brackets, enclosures, cabling, connectors, etc.) shall be appropriately sealed and/or enclosed such that they will operate continuously.

2.7.8 The CCTV system shall report CCTV subcomponent alert messages to MOMS and log diagnostics.

2.7.9 The TCS shall provide an interface that provides for the selection and control of CCTV cameras for the viewing of live streaming video.

2.7.10 The CCTV system shall have the ability to prioritize which users have control of any given PTZ camera.

2.7.11 The CCTV system shall include the ability for managing CCTV bandwidth usage.

2.8 Traffic Monitoring System (TMS)

2.8.1 The TSI shall install TMS devices based on microwave vehicle detection technology to measure traffic conditions in the express lanes and all general purpose lanes at the locations and in the travel direction indicated in *Reference 2*, Diagrams, Drawings and Schematics.

2.8.2 The TMS shall be installed on the roadside or median in a side-fire configuration and shall be capable of detecting vehicles from such a position. .

2.8.3 The TMS shall at a minimum:

2.8.3.1 Detect traffic by lane in the express lanes and all general purpose lanes at vehicle speeds between 5 and 100 mph.

2.8.3.2 Ensure that the TMS can compute, store, and provide all required traffic parameter measurements per detection Zone in user-selected time intervals

from 0 to 60 minutes, including, but not limited to, 10 seconds, 20 seconds, 30 seconds, 60 seconds, 5 minutes, 10 minutes, 15 minutes, 30 minutes, and 60 minutes.

2.8.3.3 Provide a volume accuracy of greater than 95% per direction and 90% per lane for all lanes. Provide speed accuracy of +/- 5 mph per direction and +/- 10 mph per lane for all lanes. The minimum classification accuracy shall be 80%.

2.8.3.4 Report at minimum the following in each lane:

2.8.3.4.1 Speed, with a minimum of 10 speed intervals. Speed bins will be approved by BAIFA during the design phase.

2.8.3.4.2 Volume

2.8.3.4.3 Length-based vehicle classification. Vehicle classes will be approved by BAIFA during the design phase.

2.8.3.5 Work over barriers, guardrails, medians and gores.

2.8.3.6 Allow for remote configuration and have auto-configuration of lanes/detection Zones.

2.8.3.7 Perform consistently in all weather conditions and through all temperature variations.

2.8.3.8 Be capable of monitoring its health and communicate it to MOMS.

2.8.3.9 Have dual-radar operating in the k band frequency range.

2.8.3.10 Have the ability to aggregate and transmit traffic data to the Host in time intervals approved by BAIFA during the design phase.

2.8.4 The TMS shall communicate to the Host in real time and the traffic data shall be incorporated into Dynamic Pricing. See Section 3.9.2 for use of TMS traffic data by Dynamic Pricing.

2.8.5 Each TMS shall have a unique IP address that identifies its location.

2.8.6 The TMS shall be capable of operating in a stand-alone mode if communications between the TMS and Host are down. Upon re-establishing communications with the Host, all back-logged messages shall be transmitted to the Host without affecting or degrading near real time lane operations.

2.8.7 The TMS shall be capable of storing all traffic information while in stand-alone mode for a minimum of seven days using normal traffic data collection settings.

2.8.8 The TSI may incorporate supplemental alternative TMS devices in order to capture traffic queuing data in EL and GP lanes at BATA bridge toll plaza approaches.

2.9 Electrical Work

2.9.1 The TSI shall be responsible for installation of all necessary wiring, cabling, transformers, and other equipment necessary for powering of TSI provided equipment.

2.9.2 TSI shall provide all power connections to cabinets and devices required for TCS and shall include the installation of all necessary conduits, wiring, cabling, and other equipment necessary for powering of TSI provided equipment.

2.9.2.1 TSI may provide alternative powering solutions, such as solar, subject to BAIFA approval during the design phase.

2.9.3 The TSI shall be responsible to size and terminate all power connections from the Pacific Gas and Electric (PG&E) service panels or circuits to all TCS equipment on the roadside.

2.9.4 At VTMS, Read Points and Backhaul Hubs, the electrical power and enclosure designs shall have provisions to connect portable generators to power the tolling equipment without the need for local wiring changes or revisions.

3. Host

As defined in the introductory sections of the System Requirements document, the Host serves as the central compilation and processing point of the TCS, with interfaces to a variety of external systems.

3.1 Host Processing

3.1.1 The TSI shall supply a Host that will support the express lanes Tier 1 projects and future tolling projects. The Host shall be designed and sized to accommodate approximately 350 million annual Lane Transactions and the system must be designed to be scalable to handle future tolling projects. Both the primary and backup Host server configurations shall be sized to support future growth of the Bay Area Express Lanes System including additional express lanes or other toll facilities that this system may support in the future. Large numbers of Lane Transactions will need to be analyzed to construct Trip Transactions, to assess the toll rate, and to determine violations.

3.1.2 The Host will be operational 24 hours a day, 7 days a week; therefore the hosting solution must include all necessary redundant components to achieve this availability requirement, facilitate maintenance and reduce the potential for single point failures.

3.1.3 The Host will be capable of supporting 45 simultaneous end-users and have sufficient random access memory and processing capacity to ensure a seamless and rapid response to all inputs and inquiries.

3.1.4 The Host shall be able to generate alerts to send to MOMS as defined during the design phase and include, but not be limited to, the following alerts:

3.1.4.1 Exceptions or faults

3.1.4.2 Operations outside of key performance indicators

3.1.4.3 Key processes that are not operating as designed (running too long, have not started, key indicators outside of average range).

3.2 Database

3.2.1 All stored data at the Host level shall meet the following minimum requirements without adverse system performance impact:

3.2.1.1 All Lane Transactions including exceptions shall be stored for four years. Except for all images which shall be stored for two years.

3.2.1.2 Trip Transactions and their corresponding RCSC reconciliation data shall be stored for four years.

3.2.1.3 All data necessary to run monthly and annual financial reports shall be stored for four years.

3.2.1.4 All data related to pricing, including, but not limited to, toll rates, supporting traffic data, sign displays, historical toll rates, pricing algorithm versions, incident reports, etc. shall be stored for a minimum of five years.

3.2.1.5 All data needed to follow audit trails regarding adjustments, toll rate corrections, and toll rate overrides shall be stored for a minimum of five years. All other data types, including but not limited to alarms, events, user rights tables, and RCSC file exchanges shall be stored for a length of time to be determined during the design phase.

3.2.1.6 The TCS shall allow authorized users to configure the deletion of data, as approved by BAFIA during the design phase.

3.2.2 The TSI shall provide a separate reports database as part of the Host solution. Any database design shall support the production of reports and meet functional and performance requirements. The reports database must be updated in near real time.

3.2.3 The TSI shall provide an enterprise Database Management System (DBMS) (supporting data management needs at the lane and Host levels, as well as the recovery sites) that meets the following minimum requirements:

3.2.3.1 Software and hardware must be consistent across all aspects of the system, excluding Lane Controllers.

3.2.3.2 Enforce referential integrity within applications.

3.2.3.3 Store logging data separately from application data, and store configuration data separately from application data.

3.2.3.4 Define and describe all system data elements in a metadata dictionary.

3.2.3.5 Recover to the last committed transaction at all tiers of the system.

3.2.3.6 Be configured exclusively through the selection of parameter settings.

3.2.3.7 Have data encryption capability to the element level to be determined during the design phase.

3.2.3.8 BAIFA prefers Oracle or MSSQL DBMS software. For DBMS software other than this, the TSI shall indicate how the attributes of the software meet the database requirements.

3.2.3.9 Use Structured Query Language compliant with Open Database Connectivity capability.

3.2.4 The enterprise data residing at the Host shall be the single, authoritative record of all ELN data. Accordingly, the system must provide robust audit tracking, and further, records/files must not be overwritten without confirmation and posting to an audit log.

3.3 Host Locations

3.3.1 Primary Host

3.3.1.1 The primary Host shall be located in a room provided by BAIFA at the BATA Benicia Toll Plaza in Martinez, California.

3.3.1.2 The following will be provided by BAIFA:

3.3.1.2.1 Electrical power with UPS and backup generators

3.3.1.2.2 Space for four server rack cabinets

3.3.1.2.3 Server room environmental controls

3.3.1.3 The TSI shall furnish and install a complete Host server configuration including storage, server racks, back-up library, communication/networking gear, conduits, and other hardware as needed to support requirements.

3.3.2 Secondary Host

3.3.2.1 The secondary Host shall be located in a room provided by BAIFA at their future headquarters at 375 Beale Street in San Francisco, California.

3.3.2.2 The following will be provided by BAIFA:

3.3.2.2.1 Electrical power with UPS and a backup generator

3.3.2.2.2 Two Mittal server rack cabinets (42U) with 5KW of electrical power

3.3.2.2.3 Server room and rack environmental controls

3.3.2.3 The TSI shall furnish and install a complete secondary Host server configuration including storage, back-up library, communication/networking gear, and other hardware as needed to support requirements.

3.3.2.4 The secondary Host server configuration shall have redundancy features and capabilities wherein the Host can be brought on-line and back into operations to allow the TCS to meet performance requirements.

3.3.2.5 The secondary Host data shall be synchronized with the primary Host data in near real time.

3.3.2.6 The TSI's design shall ensure that no data created in the express lanes or at other toll facilities is lost when the Host is brought back to full operation.

3.4 Hardware and Equipment

3.4.1 The Host configuration shall include all ancillary equipment needed to provide a complete and acceptable Host that meets the requirements of this Scope of Work.

3.4.2 The Host, including all major hardware elements, shall be of the latest design and shall incorporate standard commercial products currently in production. The TSI shall use server configurations that support future upgrades to processors, memory, storage, operating system, and database.

3.4.3 Host servers shall be assigned unique IP addresses that identify their locations.

3.4.4 It is recommended for the Host servers and related peripheral hardware to be supplied from the same manufacturer. All system hardware equipment performing similar functions shall be of the same manufacturer.

3.4.5 Hardware shall be commercially available, off the shelf equipment.

3.4.6 The Host shall have a method of ensuring that all devices/servers in the TCS maintain time synchronization with each other. All other computers (lane, sign, TMS, Digital Video Auditing System (DVAS), etc.) will be time synchronized either to the Host server as a primary source or to a common time synchronization source. The software used for time synchronization shall support monotonic changes to time.

3.4.7 The TCS shall ensure that there is no loss of data upon controlled system shutdown. In the event of an uncontrolled system shut down, the TCS shall lose no more than a single Lane Transaction or Trip Transaction.

3.5 Toll Roadway Operations Center

3.5.1 The TSI shall set up and support BAIFA's primary Toll Roadway Operations Center at the Caltrans Traffic Management Center (TMC) located at Caltrans District 4, 111 Grand Ave, Oakland, CA.

3.5.2 The TSI shall set up and support BAIFA's secondary Toll Roadway Operations Center at the future BAIFA headquarters at 375 Beale Street in San Francisco, California.

3.5.3 The TSI shall provide the following to set up and support the Tolling Roadway Operations Centers:

3.5.4 Video Wall Computing

3.5.4.1 The TSI shall provide computing capabilities to display all real time monitoring and CCTV generated graphics (i.e. situational awareness displays, including: roadway schematics, traffic conditions, and toll rate information; map displays and User selected GUI displays) as controlled from the dedicated monitoring workstations.

3.5.5 Dedicated User Workstations

3.5.5.1 The TSI shall provide standard personal computer workstations, peripherals, and dual monitors.

3.5.5.2 Workstations shall support up to four monitors in a large screen virtual format.

3.5.5.3 Workstations shall support simultaneous use of all delivered applications without performance degradation and loaded with the latest Microsoft Windows, Microsoft Office Professional, and computer virus protection suite.

3.5.6 Printers

3.5.6.1 The TSI shall provide a high-speed large format color laser printer that supports 11x17 print output.

3.5.7 Network Connectivity

3.5.7.1 The TSI shall provide local area network connectivity between video wall, workstations, peripherals, and Backhaul Network as approved by BAFIA during the design phase.

3.6 Host Operations Under Failures

3.6.1 In all failure modes listed below, the Host shall report through screens and alarms that it is operating in a failure mode and what the failure is. An indication of these failure modes shall appear on relevant financial, toll rate, and audit reports.

3.6.2 In the event of loss of communication with the RCSC:

3.6.2.1 The Host shall continue to use the last TSF sent by the RCSC.

3.6.2.2 The Host shall store all Trip Transactions and resume sending them when communications are restored.

3.6.2.3 The Host shall have a mechanism by which files can be manually exchanged with the RCSC.

3.6.2.4 The Host shall track which files were exchanged manually. When communications resume, it shall not send these files a second time or overwrite more current information sent by the RCSC.

3.6.3 Loss of communication with Traffic Monitoring System (TMS)

3.6.3.1 In the event that the Host loses communication with a configurable number of traffic monitoring sites in a single Zone, the Dynamic Pricing will have a failure mode that enables it to continue calculating a toll rate for that Zone.

3.6.3.2 In the event that the Host loses communication with more than the configured number of traffic monitoring sites, the Dynamic Pricing shall resort to using historical toll rates.

3.6.3.3 The historical toll rate table shall have toll rates for each Zone, day of the week, and time interval. See Section 3.9.4 for more details on historical toll rate.

3.6.4 Loss of communications with a VTMS

3.6.4.1 In the event of a long term loss of communication between the Host and a VTMS controller(s), the Host shall assign the toll rate(s) to affected Trip Transactions, based on Business Rules.

3.6.4.2 In the event of a short term loss of communication between the Host and a VTMS controller(s), the Host shall stop processing Trip Transactions associated with that VTMS controller until communication resumes.

3.6.4.3 When communications recover, the Host will use the toll rate(s) displayed on the VTMS as indicated by the VTMS controller to assign toll rate(s) to affected Trip Transactions, based on Business Rules.

3.6.4.4 The meaning of long term loss of communication shall be configurable by GUI. Any shorter loss of communication shall be considered short term loss of communications.

3.6.5 Loss of communications between Hosts

3.6.5.1 The TCS shall have the ability to distinguish loss in communications between Hosts.

3.6.5.2 The TCS shall failover to the appropriate Host without manual intervention.

3.7 Host Graphic User Interface (GUI)

3.7.1 The GUI shall include but not be limited to the following:

3.7.1.1 Web browser based GUI design for all software that requires a user interface, including the latest Mozilla Firefox, MS Internet Explorer, and Apple Safari.

3.7.1.2 Screen displays which are all printable.

3.7.1.3 The capability of allowing multiple windows to be open simultaneously with current data contents.

3.7.1.4 Browser window size which can be controlled by user.

3.7.1.5 Browser window aspect ratio which can be controlled by user.

3.7.1.6 The ability to halt a query/report request at any time.

3.7.1.7 A consistent look and feel across the entire system.

3.7.1.8 A one-step method for going back to the previous screen (i.e, a “back” button).

3.7.1.9 Access to view and print help screens throughout the system.

3.7.1.10 GUI design details will be defined and finalized during the design phase.

3.8 Express Lane Composition

3.8.1 The TCS shall contain the following logic:

3.8.1.1 Each VTMS has one or more associated Read Points.

3.8.1.2 Each Read Point and its associated VTMS(s) are assigned to exactly one Zone.

3.8.1.3 Each Zone is assigned to exactly one Segment.

3.8.1.4 Each Segment is assigned to exactly one express lane Corridor.

3.8.2 The Host shall provide user screens allowing authorized users to assign each Read Point and its associated VTMS to a Zone. The system shall limit assignments to ensure that all Read Points within a Zone are geographically sequential.

3.8.3 The Host shall provide user screens allowing authorized users to assign each Zone to a Segment. The system shall limit assignments to ensure that all Zones within a Segment are geographically sequential.

3.8.4 The Host shall provide user screens allowing authorized users to add Zones and Segments to a Corridor.

3.8.5 The Host shall make user configurable which TMS locations are used by Dynamic Pricing to calculate the toll rate for each Zone.

3.8.6 The Host shall provide user screens allowing authorized users to assign a Zone to one or more counties for revenue tracking.

3.8.7 In the event a Zone is assigned to more than one county, the Host shall provide user screens allowing authorized users to assign a percentage of revenue to each county.

3.9 Toll Rates and Trip Building

While the Host will naturally include a variety of functions employed on other toll facilities, it must also support the Dynamic Pricing and Trip Building functionalities necessary for BAIFA's express lane operation.

3.9.1 General Toll Rate Calculation

3.9.1.1 The following toll rate parameters shall be user configurable by Lane Mode, Corridor, Segment, and Zone:

3.9.1.1.1 Minimum toll rate

3.9.1.1.2 Maximum toll rate

3.9.1.1.3 Toll rate increase increment value

3.9.1.1.4 Toll rate decrease increment value

3.9.1.1.5 Discount for HOV 2

3.9.1.1.6 Discount for HOV 3+

3.9.1.2 Allowed toll rate values shall include $0.00 and values up to $999.99.

3.9.1.3 Minimum and maximum toll rates shall also be configurable by time of day and by Zone, allowing for different limits to be set by different Zones at various times of the day.

3.9.1.4 If a toll rate is directly calculated by the Host, the result will be rounded to the nearest whole cent both for display to the public and for use consistently within the system. The rounding interval shall be a user configurable value within the system.

3.9.2 Dynamic Pricing

3.9.2.1 The TSC shall support setting toll rates dynamically, Dynamic Pricing, based on near-real time traffic data.

3.9.2.2 Dynamic Pricing shall calculate pricing and display of the resulting toll rates, without manual intervention, operation, or any activity other than monitoring.

3.9.2.3 Dynamic Pricing shall calculate a toll rate for a given Zone based on traffic volumes and speeds in the EL and GP lanes at minimum. EL and GP lane density and Level of Service (LOS) may be considered for inclusion in Dynamic Pricing calculations. EL traffic conditions and GP lane traffic conditions shall be used separately by Dynamic Pricing in calculations.

3.9.2.4 Near-real time traffic data for use by Dynamic Pricing will be accessed from the TMS devices. Aggregation settings of traffic data used for Dynamic Pricing shall be configurable. The TSI may incorporate traffic queue data into Dynamic Pricing for managing traffic backups from the bridge toll plazas. It will be the TSI's responsibility to develop and implement the interfaces necessary to access the utilized sources of traffic data.

3.9.2.5 Dynamic Pricing will adjust pricing proactively, with the objective of preventing negative impacts to required levels of service. While it is understood that reactive adjustments to pricing will be required for recovery if levels of service cannot be maintained, that shall be the exception rather than the rule.

3.9.2.6 All of the Host parameters used for controlling and executing Dynamic Pricing shall be user configurable and flexible, such that EL operators can make adjustments once the express lanes are in operation.

3.9.2.7 Frequency of toll rate recalculations for all Zones within a Segment shall be configurable with parameters in the Host and may occur as often as every five minutes.

3.9.2.8 Timing of toll rate recalculations for all Zones in a Segment shall be conducted at the same time.

3.9.2.9 The recalculated toll rate shall be displayed in near real time on VTMS signs for the impacted Zone(s).

3.9.3 Variable Pricing

3.9.3.1 In addition to setting toll rates dynamically based on near-real time traffic data, the Host shall support Variable Pricing. Variable Pricing uses predetermined toll rates for each Zone based on the time of day.

3.9.3.2 Frequency of toll rate changes for Variable Pricing will be user configurable.

3.9.3.3 Variable Pricing may be used at BAIFA's discretion as an alternative or fallback means of pricing (e.g., in the event that Dynamic Pricing is not impacting traffic as desired or as a first step in pricing for a new Express Lane Facility).

3.9.3.4 The ability to use either Dynamic Pricing or Variable Pricing methods on any express lane Corridor or Zone at any time shall be fully supported.

3.9.4 Historical Toll Rates

3.9.4.1 The Host shall default to and display historical toll rates as needed. For example, this may be leveraged in cases where Dynamic Pricing is unable to recalculate toll rates due to traffic data sources being unavailable or other system failures. The historical toll rates shall be defined during the design phase between BAIFA and the TSI.

3.9.4.2 The Host shall capture, store, and maintain a history of all assigned toll rates and calculated dynamic toll rates by Zone.

3.9.4.3 This data shall be used to establish historical toll rates, and shall be made fully accessible to users with appropriate levels of security for use in operations, monitoring, and financial reconciliation and audit.

3.9.4.4 Calculation of historical toll rates shall be user configurable based on toll rate setting method, time of day, day of the week, and what time span is included in the history.

3.9.5 Toll Rate Publishing

3.9.5.1 Depending on the location of the VTMS within a Segment, the VTMS may either display one or two toll rates.

3.9.5.2 If the VTMS is not in the last Zone of a Segment, the Host will publish two toll rates to the VTMS. One will be the toll rate for the Zone where the VTMS is located in and the second toll rate is the cumulative toll rates from the VTMS's Zone through the last Zone in the Segment.

3.9.5.3 If the Zone associated with the VTMS is also the last Zone of the Segment, then only the Zone toll rate will be published.

3.9.5.4 The Host shall communicate to all VTMS within a Zone to display the same toll rates during the time period between toll rate updates.

3.9.5.5 The TCS shall allow authorized users the ability to manually publish messages to the VTMS general message line. User shall be able to publish directly to a Corridor, Segment, Zone, or a single VTMS/Read Point in both or a single direction.

3.9.5.5.1 The VTMS shall allow general message line messages to be scheduled or selected from predefined list in real time.

3.9.5.5.2 The VTMS general message line message shall have the configurability to be linked to override either or both VTMS toll Zone and Segment LED panels.

3.9.6 Toll Rate Overrides

3.9.6.1 The Host shall provide user screens which allow for manual override of the displayed toll rates by a user with the appropriate level of security clearance.

3.9.6.2 The Host shall allow manual overrides to be applied to a Corridor, Segment, Zone or Read Point.

3.9.6.3 The manual override start and end time can be at any time and for any duration.

3.9.6.4 The user shall have the ability to enter a comment with the toll rate override.

3.9.6.5 The Host will retain both the original toll and the corrected toll in the database along with the user who made the correction.

3.9.6.6 The Host shall allow users to choose messages other than toll rates for display on selected VTMS. Such messages might be "OPEN TO ALL", etc.

3.9.6.7 When non-monetary messages are displayed on a VTMS, the ability to continue to charge toll rates shall be allowed.

3.9.6.8 Based on the time duration invocation of a toll rate manual override, the Host will modify all Trip Transactions for the affected duration.

3.9.6.9 The TCS shall apply manual toll rate overrides to all relevant Trip Transactions. The TCS shall designate impacted Trip Transactions as anomalies.

3.9.6.10 If the original Trip Transactions have already been sent to the RCSC, the Host shall generate a correction file and send the Trip Transactions with corrected toll(s) to the RCSC. If the Trip Transactions have not already been sent, the Host shall send only the Trip Transactions with the new overridden toll rates to the RCSC.

3.9.7 Toll Rate Test Environment

3.9.7.1 The TSI shall create and maintain a toll rate test environment where changes to the Dynamic Pricing algorithm and its configurable parameters can be tested.

3.9.7.2 The toll rate test environment shall be capable of accepting real time and simulated traffic data as inputs.

3.9.7.3 The toll rate test environment shall have the same reporting capabilities as the Host.

3.9.8 Trip Building and Toll Rate Assignment

3.9.8.1 The Host shall process Lane Transactions received from express lane Read Points. Lane Transactions must first be assembled into a Trip, from which the Trip Transaction is built. The Host will assign the proper toll for each Trip Transaction. The TSI is responsible for designing the logic necessary to process Trip Transactions at the Host according to Business Rules. Trip Building rules will be developed during the design phase between BAIFA and the TSI.

3.9.8.2 At a high level, Lane Transactions received at the Host shall be associated to the same Trip Transaction if the Lane Transactions meet all of the following criteria:

3.9.8.2.1 Allowable travel time between Lane Transactions ('allowable' to be defined as part of design phase).

3.9.8.2.2 Transponder number, vehicle image (such as vehicle "fingerprinting"), and/or license plate number identification sufficient for association.

3.9.8.2.3 Geographically possible sequence of Read Points (for example, northbound progression).

3.9.8.2.4 The system has detected the vehicle at the minimum number of Read Points in each consecutive Zone.

3.9.9 Express Lane Trip Building

3.9.9.1 The TSI shall have a Trip Building process that forms a Trip Transaction from Lane Transactions for a given vehicle making a trip through a given Corridor.

3.9.9.2 Trip Building shall logically group Lane Transactions transmitted from express lane Read Points using the vehicle identifiers (transponder number, vehicle image, and/or license plate number) for a specific Corridor in a single direction.

3.9.9.3 The TCS shall not depend on the RCSC for providing manual image review to support Trip Building.

3.9.9.4 Trip Building shall check the time/date of Lane Transactions for Trip Building inclusion based on a configurable time range.

3.9.9.5 The number of Lane Transactions generated by a single vehicle passage through a Corridor is dependent on a number of factors, including entry and exit location; ability to accurately identify the vehicle by transponder number, vehicle image, and/or license plate number at each Read Point; date/time sequence; and other inference logic that may be necessary to build an accurate Trip Transaction. On the I-680 Corridor, for example, a vehicle travelling southbound with a transponder for the entire length of the Corridor would generate several Lane Transactions as the transponder is detected at each Read Point along the way. These Lane Transactions will cross multiple Zones and Segments, which will “lock-in” the toll rates to be charged. In this case, the Lane Transactions will be compiled into a single Trip Transaction per Corridor, including a toll based on “locked-in” toll rates, and transmitted to the RCSC for posting to the customer’s account.

3.9.9.6 The Host shall not require consecutive Lane Transactions in order to create a Trip Transaction.

3.9.9.7 The Host will make configurable the minimum number of Lane Transactions within each Zone that is required to include that Zone in a Trip Transaction.

3.9.9.8 The minimum number of Lane Transactions within each Zone that is required to include that Zone in a Trip Transaction shall be separately configurable by Zone.

3.9.9.9 The number of Trip Transactions produced in the Trip Building process will be dependent upon the number of contiguous Zones in which the minimum number of Lane Transactions were detected in the direction of travel on a Corridor. For example, if enough Lane Transactions are detected for a vehicle in the first and third of three sequential Zones, but not at the second Zone (geographically located between the other two), Trip Building shall create two separate Trip Transactions for the vehicle, one for travel in the first Zone and one for travel in the third Zone.

3.9.9.10 The Trip Building process shall form a new separate Trip Transaction from a Lane Transaction(s) whose timestamp exceeds the trip time out duration when compared to timestamps of prior Lane Transaction(s) that formed an earlier Trip Transaction in the same travel direction. The trip time out duration shall be user configurable by minutes and by Corridor.

3.9.9.11 In cases where Lane Transactions from one or more Read Points are not reporting to the Host due to communication failures or delays, the Trip Building process shall provide the flexibility to hold all Lane Transactions from adjacent Read Points and/or Zones for a configurable amount of time (maximum hold time) before performing Trip Building. This will minimize the occurrence of Trip Transactions being built without the delayed Lane Transaction.

3.9.9.12 Delayed Lane Transactions from the late-reporting Read Point(s) that exceed the maximum hold time for Trip Building shall be treated as unmatched Lane Transactions (see Exceptions and Anomalies, Section 3.12.4).

3.9.9.13 All Lane Transactions within a single Trip Transaction shall involve the vehicle travelling in the same direction, such that Lane Transactions are sequential based on date, time, geographic location, and travel direction of the Read Points.

3.9.9.14 If a Lane Transaction is associated with a completely or partially blank VTMS, the Host shall omit that Lane Transaction from the Trip Building process.

3.9.9.15 The Host shall ensure that a single Lane Transaction shall never be used in more than one Trip Transaction.

3.9.9.16 The Trip Building engine shall have processing rules for the following, but not limited to, uncommon scenarios:

3.9.9.16.1 Incorrect association of a transponder to a vehicle (transponder incorrectly associated to a license plate).

3.9.9.16.2 Extra transponder reads not associated with a vehicle.

3.9.9.16.3 Multiple transponders in a vehicle.

3.9.9.17 Trip Building shall have processing rules in order to be able to form Trip Transactions from Lane Transactions that take at minimum into consideration:

3.9.9.17.1 Where multiple license plates can be matched to a single transponder ID.

3.9.9.17.2 Where multiple transponder IDs can be matched to a single license plate.

3.9.9.17.3 ALPR error or ALPR with low confidence.

3.9.9.17.4 Multiple license plates on a vehicle (e.g. tow truck with another vehicle on a flat bed).

3.9.9.18 For Lane and Trip Transactions that have neither transponder nor license plate number, the Trip Building Process will save the records in accordance with BAIFA policy.

3.9.9.19 The Host shall designate Lane Transactions and Trip Transactions that have exceptions or anomalies associated with them in a manner that allows a user to separate those into different types of exceptions or anomalies, as defined during the design process and as approved by BAIFA.

3.9.9.20 The Host shall designate any Lane Transaction that it cannot or does not associate with a Trip Transaction as an exception.

3.9.9.21 The Host shall categorize Trip Transactions into tagged Trip Transactions, those associated with a valid transponder number, and Imaged Based Trip Transactions (IBT), those with no transponder number or an invalid transponder number. Business Rules and methodology shall be finalized during final design phase.

3.9.9.22 Each Trip Transaction shall be given an occupancy assignment of SOV, HOV 2, or HOV 3+, according to Business Rules to be finalized during final design phase.

3.9.10 Toll Rate Assignment

3.9.10.1 When a vehicle first enters a Segment, the Host shall “lock-in” the toll rate(s) displayed on the VTMS directly prior to or at the first the Read Point where the first Lane Transaction was generated by the vehicle for that Segment. The locked-in toll rates will not change if the price goes up or down while the customer is still in the current Zone or Segment.

3.9.10.1.1 If a vehicle first enters a Segment under a partially or completely blank VTMS, the Host shall use the “lock-in” toll rate(s) displayed on the next properly displaying VTMS.

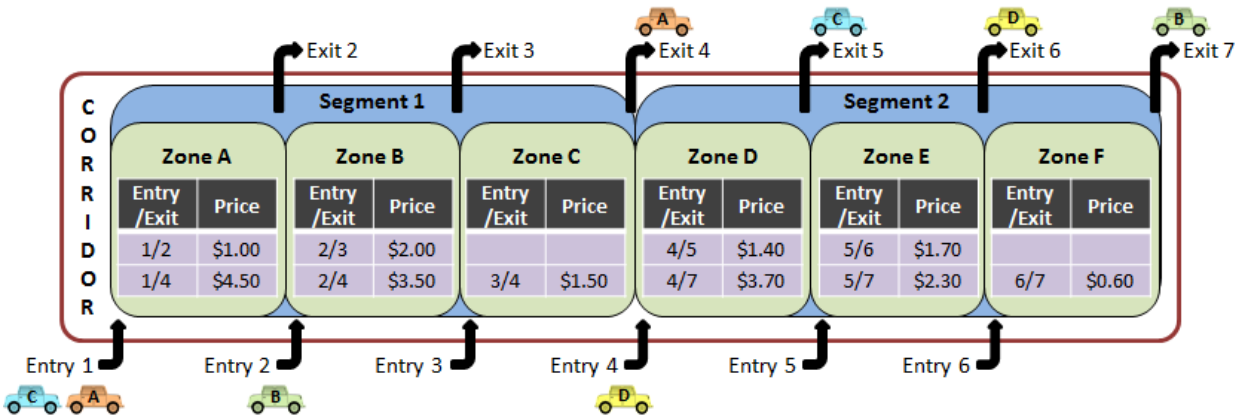
3.9.10.2 If a vehicle travels through another Segment, the Host shall “lock in” the toll rate(s) displayed on the VTMS directly prior to or at the Read Point where the first Lane Transaction was generated by the vehicle for the new Segment.

3.9.10.3 When toll rate changes are published to VTMS, the Host shall have configurable and automated calculated grace period per VTMS/Read Point location to ensure that customers are not charged a higher toll rate than was observed on the VTMS.

3.9.10.3.1 When the toll rate increases, the Host will “lock-in” the lower toll rate(s) for a configurable duration past the time the higher toll rate is published to the VTMS.

3.9.10.3.2 When the toll rate decreases, the Host will “lock-in” the lower toll rate(s) immediately.

3.9.10.4 The diagrams below provide sample scenarios to illustrate toll rate assignment concepts. Each of the colored cars is placed next to an entry below the Corridor graphic and an exit above the graphic, such that the direction of travel is from left to right. In this set of examples, there are two Segments along the Corridor, and each Segment contains three Zones. At any given time, all VTMS within a single Zone display the same toll rate.



3.9.10.5 The toll rate in effect at the time the vehicle is first detected at a Read Point within the most upstream Zone of a Segment will be used to calculate the toll for the Trip Transaction. See sample chart below with Zone toll rates and Trip Transaction tolls for each vehicle in the diagram above.

Trip	Entry /Exit	Zone A	Zone B	Zone C	Zone D	Zone E	Zone F	Total
A	1/4	$1.00	$2.00	$1.50	-	-	-	**$4.50**
B	2/7	-	$2.00	$1.50	$1.40	$1.70	$0.60	**$7.20**
C	1/5	$1.00	$2.00	$1.50	$1.40	-	-	**$5.90**
D	4/6	-	-	-	$1.40	$1.70	-	**$3.10**

3.9.10.6 If the Host and VTMS controllers have differing toll rates for a Zone, the lower toll rate will be used for that Zone for all Lane Transactions occurring during the time of the discrepancy.

3.9.10.7 In the event of loss of communications between the Host and the VTMS and the VTMS displays a historical toll rate, Trip Transactions originating in that Zone shall get the lower price between the historical and real time toll rate.

3.9.10.8 In the event of manual overrides, toll rate assignments will be based on Business Rules defined during the design process and approved by BAIFA.

3.9.10.9 The Host shall apply the SOV toll rate to Trip Transactions with an SOV occupancy assignment for the Corridor.

3.9.10.10 The Host shall provide the ability to assign separately configurable toll rate percentage Discounts (including 0% and 100%) for HOV 2 and HOV 3+ Trip Transactions.

3.9.10.11 Trip Transactions with HOV 2 or HOV 3+ occupancy assignments shall be assigned a toll equal to the SOV toll, reduced by the corresponding Discount amount.

3.9.10.12 The Host shall apply the HOV 3+ toll rate Discount to all HOV 2 and HOV 3+ Trip Transactions for Corridors with an HOV 2 occupancy requirement for carpools.

3.9.10.13 The Host shall be able to use transponder ID ranges and other information from the Tag Status File in order to assign Discounts to Trip Transactions.

3.9.10.14 At least one toll shall be applied to every Trip Transaction before it is sent to the RCSC for processing. A secondary toll may also be sent based on Business Rules to be determined during design.

3.9.10.15 The Host shall have the ability to associate a fee, in addition to the toll, to any Trip Transaction. For $0 Trip Transactions, the fee amount shall always be $0. For non-zero toll Trip Transactions, the fee shall be either a

percentage of the toll, a fixed number of cents, or the greater of the percentage and the fixed amount (configurable parameters).

3.9.10.16 The Host shall be able to add a fee based on whether the Trip Transaction is transponder-based or image-based. That is, it shall have the ability to send a fee for only transponder-based Trip Transactions, only Image-Based Trip Transactions, neither, or both.

3.9.10.17 The Host shall consider any toll rate adjustment based on any qualifying conditions known at the time the Trip Transaction is built (e.g., incidents in or impacting the express lanes).

3.10 Trip Transaction Toll Rate Corrections

3.10.1 The Host shall provide user interface screens that allow an authorized user to amend toll rates retroactively. The system shall provide the following functionality:

3.10.1.1 Allow the user to select one or more Zones and a time range. The Host shall list the Trip Transactions that contain Lane Transactions indicated by the selection criteria and display the total count and revenue.

3.10.1.2 Allow the user to select all Trip Transactions or a subset of the Trip Transactions.

3.10.1.3 Allow the user to amend the toll rate on the selected Trip Transactions.

3.10.1.4 The screen shall show the Trip Transaction list, each with the original and corrected toll rates for the selected Zones, and display the count and original and corrected revenue amounts.

3.10.1.5 The user shall have the opportunity to enter a comment with the toll rate correction.

3.10.1.6 The Host shall retain both the original toll rate and the new toll rate in the database.

3.10.1.7 The Host shall have the ability to assign a configurable toll rate (i.e, $0) to Zones in which vehicles are not able to travel at a speed over a configurable threshold. The Host shall provide a user interface for setting these configurations and for turning on and off this function.

3.10.1.8 If the original Trip Transaction has already been sent to the RCSC, the Host will generate a correction file and send the Trip Transaction with corrected toll rates to the RCSC. If the original Trip Transaction has not been sent, then only the corrected Trip Transaction shall be sent.

3.11 Rebuilt Trip Transaction

3.11.1 For Trip Transactions sent back with an "Overlapping Trip Transaction" reason code in the same RCSC reconciliation file, the Host shall attempt to build new Trip Transactions using newly provided license plate information. The Host designates these Trip Transactions as "Rebuilt" Trip Transactions. See *Attachment A-4*, Business Rules for "Overlapping Trip Transaction." If Trips Transaction cannot be rebuilt, they shall be treated as anomalies.

3.11.2 The TCS shall make turning on or off automatic rebuilding user configurable.

3.12 Real Time Monitoring

3.12.1 Real Time Monitoring Functionality

3.12.1.1 The Host shall provide a color coded zoomable interactive map of each EL Corridor on which the location and health status of the following equipment are indicated by the colors and symbols displayed:

3.12.1.1.1 Read Points, Lane Controllers and subsystems

3.12.1.1.2 VTMS

3.12.1.1.3 TMS

3.12.1.1.4 Traffic surveillance CCTV cameras

3.12.1.1.5 DVAS

3.12.1.2 The Host shall provide a real time display of processing status and counts of Lane Transactions at all Read Points.

3.12.1.3 The Host shall provide a map and graphical interface to display real time traffic conditions.

3.12.1.3.1 For each TMS location and Zone, the screens shall display real time averaged speed, volume, density, vehicle classification summary, and LOS for a user configurable time duration and for each EL and GP lane.

3.12.1.3.2 Travel time and speed shall be displayed for Zones, Segments, and Corridors for both EL and GP lanes. Calculation method for determining travel time shall be approved by BAIFA during the design phase.

3.12.1.3.3 The Host shall make user configurable the ability to enable or disable the display of each type of traffic information.

3.12.1.3.4 The representation of traffic conditions in the EL and GP lanes shall use TMS data.

3.12.1.3.5 For each VTMS location, the screens shall display the toll rates posted.

3.12.1.4 Host shall have a method of showing the history of the traffic data and toll rates for each Zone.

3.12.1.5 The CCTV interface shall at minimum:

3.12.1.5.1 Allow viewing of multiple CCTV cameras simultaneously.

3.12.1.5.2 Provide capabilities to control the PTZ functionalities of the cameras.

3.12.1.5.3 Provide capabilities to record and play back video feeds.

3.12.1.6 The Host shall provide screens which allow authorized users to report incidents on roads which affect the Express Lane Network.

3.13 Financial and Audit Functionality

3.13.1 General Financial Functionality

3.13.1.1 The financial system shall:

3.13.1.1.1 Maintain complete accountability for all transactions.

3.13.1.1.2 Ensure continuous operation and safeguard the integrity of all data collected by the system to support 24 hours a day, 7 days a week (24x7) operations.

3.13.1.1.3 Provide accurate and complete data that is reported in a timely and consistent manner.

3.13.1.1.4 Provide controls to ensure integrity of data transmission between lane, Host, and RCSC.

3.13.1.1.5 Comply with applicable current Generally Accepted Accounting Principles requirements to ensure accurate financial reporting, including revenue recognition reporting.

3.13.1.1.6 Maintain a complete "audit trail” (a record showing the source of the data and the identity of any person who makes changes or adjustments to that data and the time/date of the change) for all transactions.

3.13.1.1.7 Provide the ability to report on and reconcile all Lane Transactions and Trip Transactions.

3.13.1.1.8 Generate accounting reports with consistent results for the accounting period regardless of when the reports are run.

3.13.1.1.9 Provide reconciliation and variance detail information on each Trip Transaction sent to the RCSC.

3.13.1.1.10 Provide the ability to perform adjustments and reversals.

3.13.2 Accounting Periods

3.13.2.1 The TCS shall follow BAIFA's accounting periods. The financial system shall:

3.13.2.1.1 Provide a complete set of detail and summary daily and monthly reports to consolidate the Trip Transaction counts and revenue for each Zone and Segment and a summary for all Zones and Segments by Corridor, by county and for all Corridors.

3.13.2.1.2 Define a "Revenue Day" as the 24 hours in a calendar day.

3.13.2.1.2.1 The TCS shall assign a Trip Transaction to a Revenue Day according to the entry time of the first Lane Transaction associated with that Trip.

3.13.2.1.2.2 The TCS shall assign a Lane Transaction to a Revenue Day according to its associated Trip Transaction.

3.13.2.1.2.3 If a Lane Transaction is not associated with a Trip Transaction, the system shall assign the Lane Transaction to the Revenue Day when it occurred.

3.13.2.1.3 Report and process exceptions and variances, including Lane Transactions found after the system has processed the Trip Transactions for a calendar day.

3.13.2.1.4 Have a "monthly closing process" with a proper cut-off period to be determined by BAIFA during the design phase.

3.13.2.1.5 Provide the ability to reconcile Trip Transactions occurring during a Revenue Day/month with RCSC's posting day/month.

3.13.3 Reconciliation and Variance Analysis

3.13.3.1 The financial application shall provide the transparency and ability to track and reconcile all Lane Transactions and Trip Transactions on a daily, weekly and monthly basis and identify variances that occur as follows:

3.13.3.1.1 Lane Transactions to Trip Transactions – Variance reports and screens shall include drill down capability to identify specific Lane Transactions by Read Point, Zone, Corridor, and date or time range.

3.13.3.1.2 Files sent to the RCSC and the response file received back from the RCSC – Variance reports and screens shall include drill down capability to Trip Transaction by file.

3.13.3.1.3 Separately for ETC (tagged) Trip Transactions and IBTs (Image Based Trip Transactions), reconcile Trip Transactions occurring at the Host versus Trip Transactions sent to the RCSC – include drill down capability by Corridor and time range.

3.13.3.1.4 Separately for ETC Trip transactions and IBTs, reconcile Trip Transactions sent to the RCSC to Trip Transactions posted and sent back by the RCSC – Variance reports and screens shall include drill down capability to Trip Transaction by file, Corridor or date to locate unposted and rejected Trip Transactions. The system shall report RCSC reason codes for all Trip Transactions including unposted and rejected Trip Transactions.

3.13.3.2 The screens shall quickly identify transactions creating such variances by unique identifier, date, time, Zone (where applicable), and Corridor. The reconciliation and variance analysis process shall not require users to download and compare separate reports to discover variances or complete the reconciliation process.

3.13.4 Exceptions and Anomalies

3.13.4.1 The financial application shall allow authorized users to track, obtain reports on and process Lane Transactions designated as exceptions.

3.13.4.1.1 The TCS shall provide screens to an authorized user allowing the designation of various Lane Transaction types as “exceptions.”

3.13.4.1.2 The TCS shall not include Lane Transactions designated as exception Lane Transactions in the Trip Building process without manual intervention.

3.13.4.1.3 The TCS shall allow an authorized user to mark for inclusion in the trip building process any particular exception Lane Transactions with a proper audit trail and controls in place to handle the adjustment process.

3.13.4.1.4 When an exception Lane Transactions is marked for inclusion, the TCS shall indicate whether the adjustments will require that the system send a correction file to the RCSC.

3.13.4.1.5 The exception Lane Transactions shall include at a minimum:

3.13.4.1.5.1 Incomplete Lane Transactions – missing normal information such as images or an Optical Character Recognition (OCR) value.

3.13.4.1.5.2 Transponders without vehicles.

3.13.4.1.5.3 Lane Transactions formed from buffered transponders information. The TCS shall distinguish between those occurring with the Lane Controller operational and not operational.

3.13.4.1.5.4 Late transactions – Lane Transactions that did not get processed with others from the same calendar day.

3.13.4.1.5.5 Unmatched Lane Transactions – Lane Transactions that do not match any other Lane Transaction.

3.13.4.1.5.6 Omitted Lane Transaction due to VTMS errors.

3.13.4.1.6 The TCS shall allow users to track and get reports on Trip Transactions designated as anomalies. Anomalies shall include but not be limited to the following:

3.13.4.1.6.1 Trip Transactions with corrected or overridden tolls.

3.13.4.1.6.2 Trip Transactions where the toll rate for any Zone assigned by the pricing algorithm does not match the toll rate charged to the customer.

3.13.4.1.6.3 Trip Transactions containing Lane Transactions with a transponder set to two or more settings.

3.13.4.1.6.4 Trip Transactions containing Lane Transactions with two or more different license plate numbers.

3.13.4.1.6.5 Late Trip Transactions – Trip Transactions that were sent to the RCSC late as determined by the Business Rules.

3.13.4.1.6.6 Rebuilt Trip Transactions (see section 3.11)

3.13.5 Audit Functions

3.13.5.1 The audit application shall include, but not be limited to, the following functions:

3.13.5.1.1 Reporting Lane or Trip Transactions created under equipment malfunctions, adjusted in any way, or other exceptions and anomalies.

3.13.5.1.2 Allowing auditors to determine whether the TCS applied the correct toll to a Trip Transaction.

3.13.5.1.3 Providing screens that show historical traffic and revenue trends.

3.13.5.1.4 Providing audit screens that allow auditors to identify and research variances including, but not limited to, the following:

3.13.5.1.4.1 Traffic or revenue variances.

3.13.5.1.4.2 Expected electronic toll revenues versus RCSC actual tolls posted at summary and detail level.

3.13.5.1.4.3 Number of Image Based Trip Transactions recorded versus the number received by the RCSC at the summary and detail level.

3.13.5.1.4.4 System sent images for every Image Based Trip Transaction.

3.13.5.1.4.5 Gaps in the consecutive Lane Transaction identifier or duplicate identifiers.

3.13.5.1.4.6 All exceptions and anomalies.

3.13.6 Providing the ability to drill down from the variances identified in the reports to the supporting detail transaction data.

3.13.7 Providing access to auditor comments, incident reports, system alarms and other information that would identify the source of variances.

3.14 Customer Escalation and Transaction Research

3.14.1 The Host shall provide screens that facilitate research on data available in the database. The Host will limit the number of results returned so as not to inhibit the smooth functioning of the TCS.

3.14.2 The Host shall provide the ability to do research in areas including, but not limited to, the following:

3.14.2.1 Lane Transactions;

3.14.2.2 Trip Transactions;

3.14.2.3 Incidents;

3.14.2.4 Toll Rates;

3.14.2.5 Alarms;

3.14.2.6 User rights; and

3.14.2.7 Exceptions.

3.14.3 The Host shall limit access to each area of research depending on the user's rights. The web portal for the RCSC escalation research shall access the Lane and Trip Transaction research screens.

3.14.4 These screens shall allow authorized users to query the database using single or multiple parameters on any relevant field. For example, for a Trip Transaction query, fields shall include, but not be limited to, transponder number, license plate number, Read Points, Zones, Segments, Trip or associated Lane Transaction date and time (range), Trip or Lane Transaction number, image number, overall OCR value, method of payment, RCSC reason code, and posting date.

3.14.5 The initial return screen shall display a list detailing the subject of the query including high level information such as time, identification number, type etc. Details about the content of the summary information will be determined during the design phase.

3.14.6 The user shall be able to select any single transaction from the returned list and view the detailed information. For transactions, this includes the display of associated VES images.

3.14.7 For Trip Transactions, the user shall have the option of drilling down to a list of the associated Lane Transactions. When a user selects one of these Lane Transactions, the system shall display the same detail as if the user had selected Lane Transactions directly, including associated VES images.

3.15 Enforcement Lookups

3.15.1 General Enforcement Web Portal

3.15.1.1 The Host shall provide a password protected enforcement web portal access for CHP officers and dispatchers to retrieve data that allows confirmation of declared occupancy after pulling a vehicle over.

3.15.1.2 Users shall be able to log into the web portal using desktop computers, mobile computers in patrol vehicles, as well as with personal mobile phones.

3.15.1.3 Each user will have unique login credentials, and the duration of each active login session must be stored and accessible for reporting.

3.15.1.4 The web portal's user interface shall be intuitive and require a minimal amount of training in its use. The user interface and screen flows shall be designed in collaboration with BAIFA and CHP. The final design for the user interface shall require BAIFA's written approval.

3.15.1.5 The user shall have the option to trigger an email notification with the query results, including the lookup date/time stamp, transponder ID, license plate number, transponder switch status at the Read Points, transaction time at the Read Points, Read Point location IDs, Lane Mode, and web portal user ID.

3.15.1.6 The format of this communication must meet CHP data and security requirements for issuance of an occupancy violation citation.

3.15.1.7 The enforcement web portal shall issue notifications with the appropriate error messages when:

3.15.1.7.1 The portal is unavailable for scheduled maintenance and when it will be back up again.

3.15.1.7.2 The portal is unavailable due to communication issues with the Host.

3.15.1.7.3 Invalid data (e.g. account number, license plate, and date) has been entered.

3.15.1.7.4 A search result returns no matches.

3.15.1.7.5 A user is automatically logged out of the system. The web portal shall have a configurable inactivity timeout if no activity has occurred.

3.15.1.8 Information shall be transferred via a secured connection and documented in an Interface Control Document (ICD).

3.15.2 Occupancy Enforcement

3.15.2.1 The enforcement web portal shall also allow users to query the Host in real time for transponder status data by searching on transponder ID.

3.15.2.2 The Host must maintain a record for each query into the web portal, with the lookup date/time stamp, transponder ID, license plate number,

transponder switch status at three most recent Read Points, transaction time of a configurable number of the most recent Read Points, a configurable number of recent Read Point location IDs, and web portal user ID.

3.15.2.3 Each real time transponder query will pull the transponder switch status from the Host for a configurable number of most recent Read Points at which the transponder was detected.

3.15.3 License Plate Number Lookup

3.15.3.1 The enforcement web portal shall also allow users to query the Host in real time for transponder status data by searching on the vehicle license plate number and state rather than the transponder ID.

3.15.3.2 The web portal shall return the same Lane Transaction data for a configurable number of the most recent Read Points at which the license plate was recognized (lookup date/time stamp, transponder ID, license plate number, transponder switch status at the Read Points, Lane Transaction time at the Read Points, Read Point location IDs, and web portal user ID).

3.15.4 Historical Lane Transaction Lookup

3.15.4.1 Either the tag ID or a vehicle license plate number can be used to retrieve transponder status data for past Lane Transactions from the Host. This data may support a pursuit of occupancy violation in cases where a query could not be performed at the time of the citation, or email notification of result queries was not requested at the time of the citation.

3.15.4.2 A user shall be able to enter the citation date/time and retrieve transponder data for a configurable number of Lane Transactions from specific Read Points prior to the citation date and time.

3.16 Reporting Requirements

3.16.1 The report system shall at a minimum:

3.16.1.1 Allow users to browse, choose and run reports through a clearly displayed and user-friendly Graphical User Interface.

3.16.1.2 Provide reports based on pre-determined thresholds and support automatic distribution without any user intervention.

3.16.1.3 Support reports with single or multiple data sources.

3.16.1.4 Provide the capability to schedule reports to be run at specific times.

3.16.1.5 Provide the capability to save all reports for archiving.

3.16.1.6 Allow for showing reports on screen or downloading to Excel, PDF, or CSV files.

3.16.1.7 Provide detail and summary reports and the capability to drill down from summary reports to detailed reports.

3.16.1.8 Allow users to select date/time ranges, select Zones or Corridors or other applicable selection criteria to be determined during the design phase.

3.16.2 Ad Hoc Reports

3.16.2.1 The TCS shall provide the capability to generate ad hoc reports from the reporting database.

3.16.2.2 The technical and performance requirements shall be the same as production reports as outlined herein. Ad-hoc capabilities shall include, but not be limited to, the following:

3.16.2.2.1 Allow user to create, submit or store ad-hoc queries in a common directory for future usage.

3.16.2.2.2 Provide run-time control limits to manage large queries or downloads.

3.16.2.2.3 Provide the ability to preview ad-hoc query results and reports before downloading or printing.

3.16.3 Specific Report Requirements

3.16.3.1 The following reporting requirements are a preliminary list of the TCS activities that will require the production of reports. This list is provided to give the TSI insight into the scope and type of reports required in actual production.

3.16.3.2 Financial Reports - The system shall supply reports that support the functionality described in the accounting section above. At a minimum, these reports shall allow users to:

3.16.3.2.1 See detail and summaries of traffic and revenue for business or transaction day, month, and year by Zones, Segments, Corridors, and counties including traffic counts and toll amounts.

3.16.3.2.2 Separate ETC (tagged) and Image Based Trip Transactions and separate Home and California Toll Operators Committee (CTOC) Trip Transactions at detailed and summary levels.

3.16.3.2.3 See detail and summary variance listings by Revenue or transaction day and month.

3.16.3.2.4 Reconcile Lane Transactions, Trip Transactions and revenues separately for multiple Corridors, Zones and Read Points.

3.16.3.2.5 Reconcile TCS Trip Transaction counts and expected revenue versus RCSC transaction counts and posted revenue by Revenue day or posting day in detailed and summary level, daily and monthly or by RCSC batch file. Allow users to separate posted Trip Transactions by what type of account they posted to and by Revenue Day or posting day or by RCSC batch file.

3.16.3.2.6 Summarize Trip Transaction counts and revenue by posting date, including the ability to see what transactions from a given month posted in the next month.

3.16.3.2.7 Determine which toll rates and Lane Modes applied to each Trip Transaction.

3.16.3.2.8 Track which Lane Transactions the system consolidated into a Trip Transaction.

3.16.3.2.9 Report on CTOC Trip Transactions.

3.16.3.2.10 Reconcile files sent to the RCSC and response files sent from the RCSC.

3.16.3.3 Auditing Reports - The TCS shall supply reports that support the auditing functionality described in the accounting section above. At a minimum, these reports will allow users to:

3.16.3.3.1 Identify and explore system variances.

3.16.3.3.2 Examine exception and anomaly transactions.

3.16.3.3.3 Determine that the system took images for each Lane Transaction, sent images for Lane Transactions to the Host and sent images for each IBT to the RCSC.

3.16.3.3.4 Examine rejects and unresolved Trip Transactions from the RCSC by reason code.

3.16.3.3.5 Determine the source of variances through reporting on incidents, system alarms, Lane Modes, toll rates, and comments.

3.16.3.3.6 View overrides, corrections, adjustments and reversals.

3.16.3.4 Traffic Reports - The TCS shall supply reports that allow users to examine traffic patterns and historical trends. At a minimum, these reports will allow users to:

3.16.3.4.1 Perform trend analysis on traffic data and revenue.

3.16.3.4.2 Examine use of the EL by HOV status, including the ability to report separately on HOV 2 and HOV 3+.

3.16.3.4.3 Perform trend analysis on origin and destination of ELN users.

3.16.3.4.4 Perform trend analysis on traffic speed, density, LOS, and volumes in EL and GP lanes.

3.16.3.4.5 Compare travel times based on Trip Transactions and travel times calculated for real time monitoring in the EL and GP lanes.

3.16.3.5 Operations Reports - The TCS shall supply reports that support operations of the toll road and monitoring of traffic flows and the pricing algorithm. At a minimum, these reports shall allow users to:

3.16.3.5.1 Examine the identity, reason and toll rate change for manual toll overrides.

3.16.3.5.2 View current and past implemented toll rates by Zone.

3.16.3.5.3 Perform trend analysis and comparisons of average and maximum tolls by location, by time of day, and by Lane Mode.

3.16.3.5.4 See trends in Corridor travel times based on Trip Transactions between various destinations.

3.16.3.5.5 Show all incidents reported.

3.16.3.5.6 Perform historical analysis of Trip Transactions by specific locations included or missed, and number of locations included or missed.

3.16.3.5.7 View the number of Trip Transactions by Corridor of SOV, HOV 2, and HOV 3+.

3.16.3.5.8 View enforcement web portal activities, including but not limited to number of queries processed and emailed query results.

3.16.3.6 System Administration Reporting - The TCS shall supply reports that support the administration of the TCS. At a minimum, these reports shall allow users to:

3.16.3.6.1 Monitor system configurations by system area (i.e. VTMS, toll rate assignment, Dynamic Pricing algorithm, etc.), location (if applicable), and date range.

3.16.3.6.2 Monitor user access and rights by right category or user.

3.16.3.6.3 Monitor and log assignments and changes to user and group rights.

3.16.3.6.4 Examine at a detail and summary level, the amounts and types of usage queried by user type, by date/time range, user ID, or function. Detail will include information about the object of the user query.

3.16.3.7 System Performance Monitoring - The TCS shall supply reports that support monitoring of its performance. At a minimum, these reports will:

3.16.3.7.1 Provide historical reports to show lane accuracy and performance.

3.16.3.7.2 Demonstrate AVC, AVI and VES subsystems' performances.

3.16.3.7.3 Compare data from Lane Controllers and Traffic Monitoring Systems.

3.16.3.7.4 Monitor the ability of users to access the system, including users through the web, including but not limited to information on successful and unsuccessful attempts to log in, logout, access screens or information.

3.16.3.7.5 Summarize the comparative speed, volume and density data from adjacent AVD/AVC and TMS sites for the purposes of device "error checking" and sensor calibration. The TCS shall also be able to provide MOMS alarms if and when the two systems fall out of a configurable tolerance level from one another.

3.16.3.7.6 Show the history of the time required to build Trip Transactions by Corridor.

3.16.3.7.7 Identify sequential Lane Transactions missed in building Trip Transactions.

3.16.3.7.8 Show failure histories for various components and subsystems.

3.16.3.7.9 Show communication failures and server downtime.

3.16.3.7.10 Analyze the impact of system performance on operations and revenue.

4. Internal Data Flows

The TCS shall support near real time lane operations and Host processing, including the transmission of various data and image files between the various system components.

4.1 General Requirement

4.1.1 Any interruption of designed dataflow shall result in no loss of data, including, but not limited to, the following:

4.1.1.1 Lane Transactions

4.1.1.2 VTMS data

4.1.1.3 TMS data

4.1.1.4 Data between the primary and secondary Host

4.2 Lane Controllers

4.2.1.1 Each Lane Controller located roadside at a Read Point location will connect to the Host via the Roadside Network.

4.2.1.2 Data to be transmitted from the Host to the Lane Controllers shall include:

4.2.1.2.1 The Lane Controllers will be capable of receiving files and tables from the Host. Receipt of all files and data will be acknowledged, and any failures in the transmission shall be reported to the MOMS. Retransmission protocols will be based on Business Rules developed during the design phase.

4.2.1.2.2 The Lane Controller shall be capable of receiving and using a Tag Status File from the Host.

4.2.1.2.3 The Lane Controller shall be capable of accepting comprehensive (complete list once a day) and incremental (changes updated on a configurable interval, but not less than on an hourly basis) TSF files.

4.2.1.2.4 The Lane Controller shall activate the TSF upon receipt and after validation of the file.

4.2.1.2.5 All configuration and software files needed to support operations.

4.2.2 Data to be transmitted from the Lane Controllers to the Host shall include:

4.2.2.1 All Lane Transactions, images, all alert messages, and all operational messages generated by the Lane Controller shall be transmitted to the Host in near real time, and the delivery to the Host shall be guaranteed.

4.2.2.2 In the event of communication failures, the information shall be stored at the roadside until successful transmission is complete and verified.

4.2.2.3 Lane Controller and peripherals health and status, for use in system monitoring via MOMS.

4.2.2.4 All information shall be confirmed as received by the Host before they are eligible for deletion at the Lane Controller level.

4.3 VTMS Sign Controllers

4.3.1 Each VTMS Sign Controller located roadside at a VTMS location will connect directly to the Host via the Roadside Network.

4.3.2 Data to be transmitted from the Host to the VTMS Sign Controller shall include:

4.3.2.1 Toll rate(s) and other messages to be displayed on the associated VTMS, including both the individual Zone toll rate and the full Segment toll rate, if applicable.

4.3.2.2 The VTMS shall receive historical toll rates once a day to support stand-alone mode toll rate publishing.

4.3.2.3 All firmware, configuration, diagnostic and software files needed to support operations.

4.3.2.4 Commands to tune the VTMS.

4.3.2.5 Data to be transmitted from the VTMS Sign Controllers to the Host include:

4.3.2.5.1 Acknowledgment to the Host that the toll rate(s) were displayed on the associated VTMS at specific date and time.

4.3.2.5.2 Acknowledgement to the Host of the VTMS receiving the historical toll rate information.

4.3.2.5.3 VTMS and peripherals health and status, for use in system monitoring via MOMS.

4.4 Traffic Monitoring System (TMS)

4.4.1 Each TMS device located roadside will connect directly to the Host via the Roadside Network.

4.4.2 Data to be transmitted from the Host to the TMS shall include:

4.4.2.1 All firmware, configuration, diagnostic and software files needed to support operations.

4.4.2.2 Commands to tune TMS sensors.

4.4.3 Data to be transmitted from the TMS to the Host shall include:

4.4.3.1 Traffic data captured by time intervals, event, and sensor.

4.4.3.2 TMS device health and status, for use in system monitoring via MOMS.

4.5 Digital Video Auditing System (DVAS)

4.5.1 Each DVAS device controller located roadside will connect directly to the Host via the Roadside Network.

4.5.2 Data to be transmitted from the DVAS to the Host shall include:

4.5.2.1 Video stream data to be used for reconciliation and audit.

4.5.2.2 DVAS device health and status, for use in system monitoring via MOMS.

4.6 Closed-Circuit Television (CCTV) Cameras

4.6.1 Each CCTV device controller located roadside will connect either:

4.6.1.1 Directly to and through the Host via the Roadside Network, or

4.6.1.2 Directly to an alternative location via the Roadside Network to be determined during the final design phase.

4.6.2 Data to be transmitted from the TCS to the CCTV shall include:

4.6.2.1 All configuration and software files needed to support operations.

4.6.2.2 Commands to operate the pan/tilt/zoom functionalities of the CCTV in real time.

4.6.3 Data to be transmitted from the CCTV to the TCS shall include:

4.6.3.1 Video stream data to be used for traffic monitoring and management.

4.6.3.2 CCTV device health and status, for use in system monitoring via MOMS.

4.6.4 External viewing of CCTV by a third party shall be read-only and transmitted by the TCS.

5. Interfaces to External Systems

5.1 General

5.1.1 For interfaces with systems external to the TCS, the TSI shall communicate using an ICD developed during the design phase.

5.1.2 Any interruption of designed dataflow shall result in no loss of data to and from, but not limited to, the BATA Regional Customer Service Center.

5.1.3 ICD's shall be created or modified to describe all external hardware and software interfaces, including, but not limited to, the following:

5.1.3.1 BATA Regional Customer Service Center

5.1.3.2 Caltrans Traffic Management Center

5.1.3.3 Metropolitan Transportation Commission 511

5.1.4 Each ICD shall include file formats, message guarantee structure and receipt acknowledgement, error checking and handling, retransmission procedures, archiving and other related specifications.

5.1.5 The ICD shall address the physical, functional and performance aspects of all interfaces.

5.2 Regional Customer Service Center (RCSC)

5.2.1 As an example, the current ATCAS II and HOT Lanes Regional Customer Service Center ICD can be found as a reference in *Reference 8A*, RCSC Interface Control Documents. This RCSC ICD indicates the type of files and their structure that are currently being exchanged between the RCSC and its client agencies. Note that BATA has just procured a new RCSC that will launch in mid to late 2014.

5.2.2 Using the RCSC ICD developed during the design period, the system shall:

5.2.2.1 Send acknowledgements for all files received from the RCSC.

5.2.2.2 Reject files sent from the RCSC according to agreed upon parameters.

5.2.2.3 Process all transponder and plate files sent from the RCSC.

5.2.2.4 Process acknowledgments from the RCSC for all files sent to the RCSC.

5.2.2.5 Create alarms or notifications when the system cannot send a file, does not receive a timely acknowledgement, receives an improperly formatted file, or fails to receive a file on schedule.

5.2.2.6 Create and send files containing batches of Trip Transactions by Corridor. These files shall be separated into ETC and IBT files, each containing transactions from only one Revenue Day. The Host shall send several ETC and IBT files per day on a schedule agreed upon during design.

5.2.2.7 Make user configurable whether Trip Transactions with toll rates below a user configurable threshold will be included in the batch transaction files sent to the RCSC.

5.2.2.8 Report on transactions not sent to the RCSC.

5.2.2.9 Create and send a file containing an image set corresponding to a single IBT for every such transaction sent to the RCSC in an IBT batch file. Each image file shall contain two images from the entry point to the ELN and two images from the exit point of the Trip Transaction.

5.2.2.10 Process ETC and IBT (violation) response files, recording detailed reconciliation information for every transaction that reaches a final status at the RCSC.

5.3 Caltrans Traffic Management Center (TMC)

5.3.1 The TCS Host shall be required to interface with the Caltrans Traffic Management Center.

5.3.2 The TCS shall provide an interface with the BAVU project to allow viewing and PTZ control of the TCS's CCTV cameras, *Reference 8B,* Bay Area Video Upgrade (BAVU) Cameleon Interface Driver.

5.3.2.1 The TCS shall use the H.264 video encoding algorithm used by Caltrans.

5.3.2.2 The TSI shall use one of the following multichannel pre-approved H.264 encoders to interface with Caltrans' Cameleon video system and video wall.

5.3.2.2.1 MOXA VPort 364A-T 4 Channel H.264

5.3.2.2.2 IMPATH i5404E 4 Channel H.264

5.3.2.2.3 AXIS Q7424-R 4 Channel H.264

5.3.2.2.4 Other non-approved CCTV encoders using H.264 encoding shall require BAIFA and Caltrans approval during the design

phase and shall require integration and compatibility testing by Caltrans at the TSI's cost.

5.3.3 The TSI shall provide an interface to allow for transmitting the following data, at a minimum, to Caltrans:

5.3.3.1 For each TMS location in real time: averaged speed, volume, density, vehicle classification summary, and LOS for each EL and GP lane.

5.3.3.2 Real time travel time and speed for Zones, Segments, and Corridors for both EL and GP lanes.

5.3.3.3 Real time VTMS messages.

5.3.3.4 Real time toll rates by Zone.

5.3.3.5 Real time Lane Mode information.

5.3.3.6 Roadway characteristic information, such as Zone length, Read Point location, and TMS location.

5.3.4 The TSI shall interface with Performance Measurement System (PeMS), see *Reference 8C*, California Freeway Performance Measurement System (PeMS) – XML Interface, for transmitting the following historical data at a minimum to Caltrans:

5.3.4.1 For each TMS location: averaged speed, volume, density, vehicle classification summary, and LOS for each EL and GP lane.

5.3.4.2 Historical travel time and speed for Zones, Segments, and Corridors for both EL and GP lanes.

5.3.4.3 Historical toll rates by Zone.

5.3.4.4 Roadway characteristic information, such as Zone length, Read Point location, and TMS location.

5.3.5 The TSI shall be responsible for developing Caltrans interfaces, utilizing a BAIFA and Caltrans approved ICD.

5.4 MTC 511

5.4.1 The TCS Host shall develop an interface to the MTC 511 program, see *Reference 8D*, 511 – Open511 Protocol, utilizing a BAIFA approved ICD. The TSI shall use 511 Application Programming Interfaces (API) to transmit toll systems data or provide compelling reasons why it cannot. BAIFA must approve any other option for transmitting data to 511 if not using the 511 API.

5.4.2 The TCS shall provide the following data at a minimum:

5.4.2.1 Real time traffic data including speeds and volumes of the general purpose lanes and express lanes by TMS sensor location.

5.4.2.2 Real time and historical toll rate information by Zone.

5.4.2.3 Real time VTMS messages.

5.4.2.4 Roadway characteristic information, such as Zone length, Read Point Global Positioning System (GPS) location, and TMS GPS location.

6. Automatic License Plate Recognition (ALPR) system

6.1 General ALPR Requirements

6.1.1 The TSI shall incorporate an Automatic License Plate Recognition system to automatically and accurately derive the license plate number and state of all vehicles with at least one human readable image.

6.1.2 A human readable image is defined as follows:

6.1.2.1 The plate is not obstructed (all numbers and letters on the plate are completely visible).

6.1.2.2 A license plate appears in the image.

6.1.2.3 Sufficient brightness and clarity for a human to read the plate.

6.1.3 The TCS shall record the license plate number, state (or providence/country) and confidence level for each human readable image at either the lane-level or at the Host depending on the TSI's solution.

6.1.4 The ALPR output shall be used for the Host Trip Building process.

6.1.5 For Image Based Trip Transactions, the TCS shall send a single ALPR derived license plate number and state to the RCSC.

6.2 Confidence Values

6.2.1 A confidence level measuring the accuracy of the ALPR output shall be provided for each image.

6.2.2 A confidence value for each Image Based Trip Transaction shall be provided. Methodology for assigning confidence values will be determined during the design phase.

6.2.3 A higher confidence level or value shall be associated with a lower error rate in ALPR output.

6.3 Input Parameters

6.3.1 The ALPR system shall accommodate and integrate user parameters based on input from BAIFA. These parameters shall be determined during design.

6.3.2 The parameters shall be used to modify and optimize the system behavior. For example, parameters allowing use of confidence levels to determine which images are sent to the RCSC .Such parameters will be designed with the TSI and will be based on availability of images, confidence level of individual images, state of plate, and correlation between ALPR values.

7. Lane Modes

7.1 Lane Operational Requirements

7.1.1 The TCS shall be able to operate in different Lane Modes, to be determined by BAIFA during the design phase to account for operational situations such as a following, but not limited to:

7.1.1.1 Maintenance being done on various part of the TCS

7.1.1.2 Normal tolling hours

7.1.1.3 HOV only operations

7.1.1.4 Non-tolling hours

7.1.1.5 When traffic incidents impact the EL

7.1.2 The TCS shall include, but not be limited to, the following functionalities for each Lane Mode:

7.1.2.1 An assignment of a Lane Mode to one or more Corridors, Segments, Zones, or Read Points.

7.1.2.2 Allowable times and dates that each Lane Mode can be assigned within.

7.1.2.3 A toll rate setting method associated with each Lane Mode as being Dynamic Pricing, Variable Toll Rate, historical, or no pricing (not tolling).

7.1.2.4 Allow each Lane Mode be automatically entered by system (for example, when the maximum toll rate is reached within a Zone) or manually entered by user intervention.

7.1.2.5 Enable the VTMS the ability to display current toll rates and/or input custom messages under each Lane Mode.

7.1.2.6 Support activating occupancy enforcement beacons on or off.

7.1.2.7 Support activating VES cameras on or off.

7.1.2.8 Allow the collection of AVI reads or not.

7.1.2.9 Allow the collection of TMS data or not.

7.1.2.10 Allow for Lane Transactions to be created during the Lane Mode or not.

7.1.2.11 Allow for Trip Building from Lane Transactions created during the Lane Mode or not.

7.1.2.12 Allow for a configurable minimum duration for any Lane Mode.

7.1.2.13 Allow for a configurable Discount for HOV 2 and HOV 3+.

7.1.3 Each Lane Mode shall have a unique identifier. The number of and configurations for specific Lane Modes will be determined during the design phase.

7.1.4 The TCS shall have a default Lane Mode, to be determined during the final design stage.

7.1.5 The TCS shall allow through a GUI authorized users to create Lane Modes and shall allow authorized users to apply Lane Modes in an intuitive and easy matter.

8. Digital Video Auditing System (DVAS)

8.1.1 In order to support auditing and to troubleshoot and diagnose performance issues and other systemic problems in the Express Lanes, the TSI shall provide a DVAS with video and data audit capability to be used to conduct an independent audit.

8.1.2 The TSI shall provide a DVAS system integrated into the Host and/or two mobile DVAS's that shall be used to audit the system and diagnose system problems.

8.1.3 The DVAS shall provide the capability to monitor an overall video of the tolling location and display detailed events as they occur in real time, including Lane Controller transaction data.

8.1.4 Upon identification of a systemic problem or degradation in the TCS performance or as requested by BAIFA, the TSI shall install the DVAS on a specified Read Point and perform an independent audit to verify system performance.

8.1.5 The TSI shall ensure that the DVAS can be installed without any hardware or software changes to the operational system.

8.1.6 The DVAS shall have the capability to display video and data in real time and also record up to 48 hours of video and data to an electronic media for future review.

8.1.7 The DVAS shall include, but not be limited to:

8.1.7.1 Digital cameras

8.1.7.2 Data recorder

8.1.7.3 Digital Video Recorder and Player

9. Communication Network Requirements

9.1 General Requirements

9.1.1 The TSI shall provide for a TCS Network which includes:

9.1.1.1 Roadside Network

9.1.1.2 Host sites

9.1.1.3 Operations Center

9.1.2 The TSI shall also be responsible to provide and configure network devices with all necessary protocols and functionality to implement communications between all elements of the tolling system, external systems as required by BAIFA, and the Backhaul Network.

9.1.3 TSI shall furnish all required network electronics, software, cables, and components necessary to support communications. Items to be furnished shall include but not be limited to:

9.1.3.1 Fiber-Optic Cable

9.1.3.1.1 Furnish, install, and test all underground and outdoor single mode fiber-optic (SMFO) cables and cable terminations.

9.1.3.1.2 SMFO cable shall meet or exceed all TIA/EIA standards applicable to fiber optic cables and fiber optic terminations.

9.1.3.1.3 SMFO cable length shall be appropriate for each installation and provide additional spare length for service loops.

9.1.3.1.4 The SMFO cable shall be of type and quality to support the implementation of optical wavelength division multiplexing.

9.1.3.1.5 SMFO pigtails shall be provided with appropriate factory-assembled connectors on one end.

9.1.3.1.6 Fiber cable specifications shall be further developed as part of the design stage and all materials and quantities shall be approved by BAIFA. The TSI shall provide 100% spare fiber capacity or 24 spare fiber strands, whichever is greater.

9.1.3.1.7 Furnish, install and test SMFO drop cable that meets the material requirements described above for single mode fiber-optic cable.

9.1.3.2 Fiber-Optic Splice Centers, Splice Interconnect Centers and Interconnect Centers

9.1.3.2.1 The TSI shall furnish and install compact, modular fiber-optic interconnect centers, fiber-optic splice enclosures, housing and all necessary hardware.

9.1.3.2.2 The TSI shall also modify existing fiber-optic interconnect centers and/or splice enclosures.

9.1.3.2.3 Provide connector panels with appropriate connectors that are compatible with existing interconnect centers.

9.1.3.2.4 Specifications for splice center, enclosure, interconnect centers and all necessary hardware shall be further developed as part of the design stage and all materials and quantities shall be approved by BAIFA.

9.1.3.2.5 The TSI shall use fusion splicing methods and materials. No mechanical splicing shall be used by the TSI.

9.1.3.3 Ethernet Cable

9.1.3.3.1 Provide Category 6 Ethernet cable that complies with American National Standards Institute (ANSI)/TIA standards.

9.1.3.3.2 Outdoor Cable shall be shielded, outdoor-rated and have an ultraviolet light (UV)-resistant jacket.

9.1.3.4 Patch Panel

9.1.3.4.1 Provide patch panels to terminate all Ethernet cable plus 100% spare.

9.1.3.4.2 Patch panels shall have write-on areas for port and panel identification. The patch panels shall be designed for Category 6 cable and shall meet TIA/EIA-568-A-5 Category 6 and ISO 11801 Class D standards.

9.1.3.5 Ethernet Communications Hardware

9.1.3.5.1 Furnish and install Gigabit Ethernet communications hardware that is compatible with the existing BATA network and Backhaul Network.

9.1.3.5.2 Provide Management of each Ethernet communication device individually and as a group for switch configuration, performance monitoring, and troubleshooting.

9.1.3.5.3 Fully compatible and interoperable with the trunk Ethernet network interface.

9.1.3.5.4 Support a virtual chassis configuration (i.e., stacking).

9.1.3.5.5 Provides Simple Network Management Protocol (SNMP), Remote Monitoring (RMON), switch monitoring (SMON), or the Trivial File Transfer Protocol (TFTP) and Telnet interface support.

9.1.3.5.6 Network Time Protocol (NTP) for an accurate and consistent timestamp.

9.1.3.5.7 Support port mirroring for troubleshooting purposes when combined with a network analyzer.

9.1.3.5.8 Support of remote and local setup and management via console port, telnet, secure shell (SSH) and secure Web-based GUI.

9.1.3.5.8.1 Shall provide local and centralized Authorization Authentication Accounting (AAA) for user authentication.

9.1.3.5.8.2 Shall utilize RADIUS remote access services.

9.1.3.6 Network Management Software

9.1.3.6.1 The Network Management System (NMS) software shall provide a secure, simple, intuitive interface to the network administrator for monitoring and maintenance of the TSI network.

9.1.3.6.2 Furnish and install NMS software that shall provide global and device specific configuration and protocol management, troubleshooting and root-cause analysis, security, and system performance and health monitoring for the TCS communications network.

9.1.3.6.3 The NMS provide network alarms and health status to MOMS.

9.1.3.6.4 The NMS shall be web-based. Any database software that is required to support the NMS shall be included as incidental with the NMS software.

9.1.3.6.5 The NMS shall provide centralized AAA for user authentication.

9.1.3.6.5.1 The NMS shall provide multi-level or role-based access control.

9.1.3.6.5.2 The NMS shall utilize active directory for access control.

9.1.3.6.5.3 The NMS shall utilize RADIUS remote access service.

9.1.3.6.6 The NMS shall support any common network device that supports SNMP v1, SNMP v2, or SNMP v3. Configure the NMS to provide BAIFA read only access for monitoring purposes.

9.1.3.6.7 The NMS shall be scalable to allow for future growth of the BAIFA system. The NMS shall provide for the ability to expand the licenses in the future to continue to monitor new devices as they are added. The initial BAIFA deployment shall contain approximately 350 managed devices. The NMS shall be expandable to handle 700 devices or more with no additional hardware requirements. For bidding purposes, the initial deployment shall be 350 managed devices, with the capability to expand to 700 devices through additional license purchases, which are not required as part of this bid.

9.1.3.6.8 Layer 2 / 3 network discovery shall be provided with licenses for up to 350 switches. These switches are inclusive of the 700 network devices described above, but have the added requirement of automated network discovery and mapping capability

9.1.3.6.9 The NMS shall provide functions to capture, modify, print and save and restore running configurations on all TCS network communications device.

9.1.3.6.10 The NMS shall provide functions to update and roll back firmware to all TCS network communications devices via TFTP and additionally, any of the following:

9.1.3.6.10.1 Secure File Transfer Protocol (SFTP)

9.1.3.6.10.2 SSH

9.1.3.6.10.3 Hypertext Transfer Protocol Secure (HTTPS)

9.1.4 The TCS communications solution shall provide for expansion and scalability.

9.1.5 The TCS shall prioritize data traffic from each Corridor over the TCS network in the following descending order: VTMS communications, Lane Controller health communications with MOMS, TMS communications, other data traffic not specifically called out in this list, CCTV video feeds, and Lane Transactions.

9.2 BATA/BAIFA Backhaul Network

9.2.1 The TSI shall utilize the Backhaul Network for communications between the Corridors, the primary and secondary Host sites, and the primary and secondary Toll Roadway Operations Center sites.

9.2.2 The Backhaul Network bandwidth is shared between varieties of projects and will be managed by BATA/BAIFA to ensure consistent performance and optimal load-sharing. For connections to the Backhaul Network, the TSC will be limited to Backhaul Network bandwidth capacity. Bandwidth between the Roadside network and Backhaul Hubs with fiber optic links shall be limited to a bandwidth of 3 Gbps. Primary and Failover communications paths of the Roadside network to Backhaul Hub locations with 1 Gbps MetroE links, will be constrained to 1 Gbps MetroE. See *Reference 2,* Diagrams, Drawings and Schematics, "Backhaul Network Topology View" for the Backhaul Network topology.

9.2.3 All TSI switches connecting to the Backhaul Network shall provide the functions of a Layer 2 Ethernet switch and a Layer 3 router with advanced CoS/QoS capabilities.

9.2.4 The TSI shall be responsible for connectivity to Backhaul Network cabinets, structures and facilities, and network port connections from the Roadside Network into the Backhaul Network.

9.2.5 Backhaul Network information is provided in *Reference 3*, Communications Network Conceptual Pre-Design.

9.3 Roadside Network

9.3.1 The Roadside Network shall include:

9.3.1.1 Corridor communications between tolling elements on the roadside and with the Backhaul Network at Backhaul Hub locations.

9.3.1.2 Fault tolerance functionality and capabilities, protection from single points of failure, and other protection capabilities as required.

9.3.1.3 Roadside Network communication device ports capable of Gigabit Ethernet.

9.3.1.4 All Roadside Network hardware and software necessary to provide access, connectivity, and network functionality, including but not limited to routing, switching, security, and QoS.

9.3.1.5 Any physical access proposed or required for communications as part of the TSI's design, including but not limited to wired, wireless, microwave, and leased line services shall be planned, design, configured, operated and maintained by the TSI.

9.3.1.5.1 If leased lines are used, any leased services shall be procured and maintained at the TSI's expense.

9.3.1.5.2 If fiber is used, new trunk fiber-optic cable shall be used.

9.3.1.5.3 Fiber optic cable can use available BAIFA designated conduit as identified in *Reference 2*, Diagrams, Drawings and Schematics. The use of any identified empty BAIFA designated conduit shall be coordinated with BAIFA. The use of non-empty conduit is subject to BAIFA approval."

9.3.1.5.4 In locations where the Backhaul Network trunk fiber is located along the Corridor, access to 12 strands of Backhaul Network trunk fiber will be made available to the TSI. Access to more than 12 strands of Backhaul trunk fiber is subject to availability of fiber strands and BAIFA approval. The TSI shall coordinate with BAIFA for access to any Backhaul network fiber strands.

9.3.1.6 Connectivity between the Backhaul Network and the TCS Network as shown in *Reference 2,* Diagrams, Drawings and Schematics, and final placement, optical budgeting and sizing shall be determined during the Critical Design phase.

9.3.1.6.1 The TSI shall perform link budget analysis to determine the appropriate optical SFP GBIC type required (i.e., LX, ZX, etc.).

9.3.1.6.2 Backhaul locations are detailed in *Reference 3*, Communications Network Conceptual Pre-Design and *Reference 2*, Diagrams, Drawings and Schematics, "Backhaul Network Topology View."

9.4 Host Communications

9.4.1 The TCS shall provide communications at primary and secondary Hosts. Communications solution shall have fault tolerance functionality and capabilities, protection from single points of failure, and other protection capabilities as required.

9.4.2 TSI shall provide and configure network communication within the Host site.

9.4.3 TSI shall provide and configure network communication from the Host site to each Corridor. Access to the roadside toll system shall be provided through interface with the Backhaul Network.

9.4.4 TSI shall provide and configure network communication between the primary and secondary Host sites. Access to the Host sites shall be provided through the Backhaul Network.

9.4.5 TSI shall provide and configure network communication from the Host site to the RCSC. Access to the RCSC shall be provided through the Backhaul Network.

9.4.6 TSI shall provide and configure network communication from the Host site to the external systems, see Section 5, based on Interface Control Documents developed.

9.5 Toll Roadway Operations Center Communications

9.5.1 The TSI shall support communications at BAIFA primary and secondary Toll Roadway Operations Center, including:

9.5.1.1 Hardware and software necessary for communications connection to the Backhaul Network.

9.5.1.2 Hardware and software necessary communications between tolling equipment within the Toll Roadway Operations Center sites.

10. Maintenance Online Management System (MOMS)

10.1 MOMS Functionality

10.1.1 The TSI shall provide a fully integrated MOMS application that automates the tracking and reporting of work orders, alarm messages, equipment inventory, equipment and network health.

10.1.2 The MOMS shall have the ability to support configurable alarm priorities, as well as maintenance personnel tracking, paging and assignments.

10.1.3 Critical alarms shall contact the maintenance personnel on duty. The system shall be able to contact multiple people for a given alarm.

10.1.4 The system shall track response, repair and total down times associated with work orders generated through the alarm subsystem.

10.2 Alarms and Alerts

10.2.1 The system shall provide a wide variety of system alarms and alerts, as well as system administration of alarms/alerts. These shall be developed to comply with BAIFA's specific design specifications, including prioritization and management, to be developed during the project design phase.

10.2.2 These shall alarms and alerts shall include but not be limited to:

10.2.2.1 Preventive maintenance program – define and track preventive maintenance program activity, costs and system performance results.

10.2.2.2 Supplier information – company name, contact person name, company address, telephone number(s), fax number(s) and email address.

10.2.2.3 Equipment inventory – part or component supplier, location, serial number, purchase date, price, date placed into service, warranty expiration date, BAIFA asset number and part/component identification.

10.2.2.4 Error detection.

10.2.2.5 Equipment conditions.

10.2.2.6 Logical conditions/Business Rule exceptions.

10.3 Work Orders

10.3.1 Automated and manual work orders shall be supported by the MOMS.

10.3.2 The automated work orders shall be generated for scheduled preventive and predictive tasks as well as for alarms generated by equipment in the lanes or Host.

10.3.3 The MOMS shall require that any updates to the maintenance work order, alarm response, and maintenance activity be appended to the ticket with a searchable date and time stamp to record the entire history of the activity.

10.4 Asset Inventory and Tracking

10.4.1 The inventory portion of the MOMS shall track equipment and spare parts and shall generate automated messages when warranties are nearing expiration or when levels of spare inventory reach a configurable minimum threshold.

10.4.2 Inventory information shall include, but not be limited to:

10.4.2.1 Supplier information – company name, contact person name, company address, telephone number(s), fax number(s) and email address.

10.4.2.2 Location.

10.4.2.3 Serial number

10.4.2.4 Purchase date.

10.4.2.5 Price.

10.4.2.6 Date placed into service.

10.4.2.7 Warranty expiration date.

10.4.2.8 BAIFA asset number and part/component identification.

10.4.2.9 Consumable inventory – traffic light bulbs or other items that are ordered in bulk and do not have an individual serial number.

10.5 Reporting

10.5.1 The MOMS reporting system shall support the generation of reports that provide the following types of data:

10.5.1.1 Equipment inventory including hardware, software and firmware versions, serial numbers and warranty information.

10.5.1.2 Equipment, subsystem and total system availability.

10.5.1.3 Summary and detail history of alarms (preferably using drill down functionality).

10.5.1.4 Summary and detail work order status.

10.5.1.5 Incident logs.

10.5.1.6 Response and repair time by maintenance personnel, TCS location and priority.

10.5.1.7 Preventive and corrective maintenance history including component failure rates.

10.5.1.8 Equipment use and repair history.

11. Security and Access Control

As a revenue collection system impacting express lane drivers, it is critical that the systems, data, and physical locations of all components are appropriately protected against unauthorized access.

11.1 System and Data Security

11.1.1 Access to all data stored at the Host facilities shall be limited to authorized personnel including BAIFA, the TSI and EL operations personnel, and shall be password controlled.

11.1.2 The access control system (proximity card or active directory) shall be housed on BAIFA's network and will be owned and managed by BAIFA.

11.1.3 The access control shall apply to all applications using the network.

11.1.4 Each user shall have only one user ID and one password for access to any part of the system to which s/ he is authorized. This ID and password shall protect not only the user interface but command line and database access as well. User identification will be facilitated by BAIFA active directory servers.

11.1.5 Access control privileges will be role-based and use active directory groups, group membership and group permissions to control user access to configuration parameters, GUI, reports, and other functionalities as determined during final design phase. The TSI shall develop an Access Level Matrix during final design phase.

11.1.6 The system shall have the ability to require passwords to be changed periodically. The system shall be configurable so that the period may be changed without additional programming. Password challenge, authentication, length, reuse and expiration shall be designed in accordance with Microsoft Active Directory standards.

11.1.7 The application authentication shall be mapped into the operating system and not placed inside an individual application.

11.1.8 BAIFA will be the administrator of the security component of the new TCS.

11.1.9 All Host, network electronics and software shall be free of all known security vulnerabilities, worms and viruses.

11.1.9.1 The TCS should incorporate the use of BAIFA's McAfee Enterprise Antivirus software.

11.1.10 Microsoft Active Directory is the required solution for authentication and access control.

11.1.11 The new TCS shall comply with BAIFA's security/audit policies.

11.1.12 The TCS shall provide network security including, zone based access control, and stateful packet inspection and filtering of authorized source and destination IPs, protocols and protection against attacks to the TCS system.

11.2 Security Audit

11.2.1 The TCS shall at a minimum:

11.2.1.1 Provide audit and accountability control functions.

11.2.1.2 Enable security event logging, collection, storage, and monitoring.

11.2.1.3 Implement the information collection and reporting processes for detection, analysis, and response to security incidents and events.

11.2.1.4 Implement secure storage of audit logs, collect machine state and system usage information, and all items required for forensic investigations.

11.2.1.5 Provide audit logging features for tracking database activity which includes but is not limited to read, write, and modify. Each record shall include (at minimum) a time stamp, the activity, the result, and requester.

11.3 Physical Security

11.3.1 A security access control system shall be utilized that will monitor and record all access to secure locations including, but not limited to, primary and backup Host locations.

11.3.2 Access to computer equipment shall be restricted and only authorized personnel shall be allowed to enter the computer rooms.

11.3.3 Access to all toll collection enclosures and cabinets will be key/lock controlled. All new cabinets and housings installed under this Scope of Work will be access controlled using keys/locks. All cabinet and enclosure keys shall be unique to the BAIFA Toll Collection System and not interchangeable with Caltrans key sets.

11.3.4 Access to Lane Controller, VTMS, TMS, and CCTV cabinets shall be recorded automatically and transmitted to the MOMS.

Appendix 1 - Attachment A-2

BAIFA
BAY AREA INFRASTRUCTURE FINANCING AUTHORITY

BAIFA Express Lane Network

Toll Collection System

Implementation Requirements

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Introduction

The purpose of the implementation requirements is to address the areas that shall constitute a proper implementation according to the Bay Area Infrastructure Financing Authority (BAIFA). These requirements do not preclude the Toll System Integrator (TSI) from providing additional coordination or documentation that provide for an efficient implementation, tracking of tasks and project control.

1. Project Management

1.1 General

1.1.1 The TSI shall be responsible for management of the planning, execution, and control of all aspects of the project. The TSI shall also be responsible for coordinating its activities with BAIFA, the Civil Contractor(s), and other entities that are directly or indirectly impacted by the TSI's Work. The TSI shall be responsible for documenting and reporting on all aspects of the project.

1.1.2 The TSI shall provide project management throughout the lifecycle of the project. The TSI shall develop and deliver the project management documents listed in this section.

1.1.3 The TSI shall schedule all documents in the project management section for BAIFA approval according to Attachment B, Schedule and Project Milestone Dates. The schedule shall allow time for BAIFA review and TSI updates according to the requirements in Section 1.3.6, Deliverable Management.

1.2 Project Initiation Conference

1.2.1 The TSI shall participate in a Project Initiation Conference by the date required in the Attachment B, Schedule and Project Milestone Dates. BAIFA will coordinate and moderate the conference. The conference should last no more than one (1) Day. Agenda items for this conference shall include, but not be limited to:

1.2.1.1 Introduction of key TSI staff to BAIFA and BAIFA's project partners.

1.2.1.2 Collaboration on core elements of the system design, the development process, coordination with the civil project, and coordination with the network communications project component.

1.2.1.3 Review of key aspects of the Project Management Plan (PMP), the initial Project Schedule, the Subcontractor Management Plan, Quality Management Plan, Project Communications Plan, and any other early project coordination.

1.3 Project Management Plan

1.3.1 The TSI shall develop and submit to BAIFA for review a draft and a final Project Management Plan in accordance with the schedule in Attachment B, Schedule and Project Milestone Dates.

1.3.2 The Project Management Plan shall identify the specific processes, tools and techniques that provide full, frequent and routine transparency to BAIFA for all work being performed under the Agreement.

1.3.3 The TSI's management approach shall be described within the Project Management Plan, which shall describe all components of an effective and efficient management system, including but not limited to: communication and reporting; documentation; supervision of personnel and activities; all tools, facilities, and materials; environmental protection and mitigation; safety of personnel, motorists, and the general public; and any other management elements needed to produce and document a high-quality, safe, efficient, and operable Toll Collection System (TCS) that minimizes environmental and traffic impacts. The PMP shall specifically address the following areas:

1.3.3.1 Risk management, which includes identifying, tracking and addressing project risks

1.3.3.2 Change management, which includes processes for managing impacts of changes on people, processes, data and technology, and mitigating any negative consequences

1.3.3.3 Change control, which includes procedures for tracking potential and approved change orders, complying with BAIFA's change control procedures, and updating all related documentation and work orders to reflect changes approved by BAIFA

1.3.3.4 Configuration control, which includes procedures for tracking potential, approved and implemented changes to Hardware, software, and their configurations and updating all related documentation

1.3.3.5 Inventory, which includes processes for managing the purchase, delivery, storage, tracking, installation, and reporting of all equipment needed for the project, as well as spares

1.3.3.6 Coordination planning, which includes identifying stakeholders (e.g. civil and communications) and critical coordination dates, and developing plans to ensure coordination and dates are met

1.3.3.7 Deliverable management, which includes the process for producing high quality deliverables that meet the requirements described in Section 1.3.6

1.3.3.8 Project schedule as described in Section 1.3.4

1.3.3.9 Personnel management as described in Section 1.3.5

1.3.4 The PMP shall be updated at least annually, and after major changes in project management procedures, unless otherwise agreed to in writing by BAIFA

1.3.5 Project Schedule

1.3.5.1 Within 30 Days of notice to proceed (NTP), the TSI shall update and submit to BAIFA for approval an update to the proposed Project Schedule. The Approved Project Schedule shall become part of the Agreement and the basis for the TSI's scheduling of its Work under the Agreement.

1.3.5.2 The Project Schedule shall be comprehensive of all project phases and Corridors, and shall include sufficient information on all activities required to enable proper control and monitor progress.

1.3.5.3 The Project Schedule shall be resource-loaded critical path method schedule using Microsoft Project or a similar, program proposed by the TSI.

1.3.5.4 The Approved Project Schedule shall be updated and submitted to BAIFA for approval every calendar month throughout the term of the Agreement.

1.3.5.5 Upon written approval by BAIFA, the updated Approved Project Schedule shall become part of the Agreement, superseding the previous Approved Project Schedule.

1.3.5.6 Submission of the monthly revisions to the Project Schedule shall not release or relieve the TSI from full responsibility for completing the work within the time set forth in the previous Approved Project Schedule.

1.3.5.7 BAIFA's approval of the Project Schedule does not relieve the TSI from any liability for Liquidated Damages for Tolling Commencement Milestones.

1.3.5.8 Changes to Tolling Commence Milestones require a Change Order. BAIFA's approval of the Project Schedule does not relieve the TSI from any liability penalties associated with Performance Requirements.

1.3.5.9 To accommodate BAIFA's review of the Project Schedule, the TSI shall submit all files in native and PDF format.

1.3.5.10 The planning, design, installation, and completion of the project shall be undertaken and completed in accordance with the most recent Project Schedule accepted by BAIFA.

1.3.5.11 The Project Schedule shall be used by the TSI and BAIFA for planning and monitoring progress of the Work.

1.3.6 Work Breakdown Structure (WBS)

The TSI shall provide revisions to the existing WBS used by the BAIFA Express Lane Network (ELN) project team as found in *Reference 7*, Preliminary Work Breakdown Structure. Once approved by BAIFA, the agreed upon WBS shall be incorporated into the Project Schedule.

1.3.6.1 Milestones

The Project Schedule logic shall reflect a critical path from notice to proceed through completion of the project. Each Milestone shall be separately identified, shall conform to the scheduling requirements in the Agreement, and shall be assigned a "finish no later than" constraint date. The TSI shall reflect Milestones and their required Guaranteed Delivery Dates from Attachment B, Schedule and Project Milestone Dates, in the Project Schedule.

1.3.6.2 Activities

Each Project Schedule submittal shall clearly and individually define the progression of the project within the applicable timeframe by using separate project activities, including but not limited to:

- Milestones
- Qualifying Event required for Milestone completion
- Dependencies on critical activities performed by other project partners and contractors
- All Work components, including management, and quality assurance activities
- Documentation development and delivery
- BAIFA documentation review and documentation updates
- System design and testing, including communications network
- Installation activities
- Procurement and delivery of equipment and materials
- Traffic control activities

The Project Schedule submittal shall clearly and individually define the progression of the project within the applicable time frame by using separate project activities with appropriate logic ties.

TSI shall use standard and consistent WBS identification numbers associated with each activity, textual descriptions, and codes in all Project Schedule submittals.

1.3.6.3 Corridor Schedules

At BAIFA's direction, the TSI shall provide a detailed schedule for each Corridor in addition to the comprehensive Project Schedule. Corridor schedules shall provide additional detail to account for interdependencies with third parties, including but not limited to the Roadway Contractor, utility providers, and Caltrans. Corridor schedules shall meet all of the requirements defined herein for the Project Schedule.

1.3.7 Personnel Management

1.3.7.1 Team Organization

The PMP shall describe the TSI's project team organization and reporting relationships, including key project personnel, and list team member contact information. The TSI shall include a project organization chart that is a graphic representation of the hierarchy and indicates functional areas of responsibility. Any subcontractor relationships and responsibilities shall be accurately reflected in the PMP and corresponding organizational chart. The PMP shall describe the extent to which TSI personnel shall be on site at BAIFA.

1.3.7.2 Key Project Personnel

The following list identifies individuals from the TSI's organization as key project personnel:

- Project Principal
- Project Manager
- System Design Manager – Responsible for managing the entire toll system design including all roadside and data center elements as well as overall system security and compliance.
- Software Development Manager – Responsible for the development of the Host and Roadside System Hardware and software.
- Communications Development Manager – Responsible for the design and development of all communications functionality and systems.
- Installation Manager – Responsible for the installation of the entire toll system from planning to acceptance.
- Maintenance Manager – Responsible for the ongoing maintenance of the system to meet functional and performance requirements.
- Project Quality Manager – See Section 1.4.4

1.3.8 Deliverable Management

The TSI shall define deliverable management processes and activities in the Project Management Plan and shall comply with requirements detailed in this section.

Submittals

1.3.8.1 All deliverables and work products shall be submitted to BAIFA for review, comment and approval.

1.3.8.2 BAIFA has the authority to determine whether all documents and work products receive approval including, but not limited to, design documents, planning documents, user manuals and test results. The TSI shall obtain BAIFA approval in order to qualify for payment under Attachment B, Schedule and Project Milestone Dates.

1.3.8.3 Upon submittal, BAIFA may perform a cursory review to accept the deliverable; deliverables may be rejected within ten (10) working days at the sole discretion of BAIFA if content is missing or incomplete. In the event a deliverable is rejected, BAIFA's project manager (PM) will notify the TSI's PM

in writing. Rejection of an incomplete deliverable will constitute a delay caused by the TSI.

Document Reviews

1.3.8.4 The TSI shall submit deliverables for BAIFA's review and approval in sufficient time for a minimum of two (2) iterations of review and revision to be completed and still adhere to the Project Schedule. Multiple simultaneous submittals of deliverables may extend BAIFA's review times.

1.3.8.5 The TSI shall submit an empty comments matrix with each document. BAIFA will enter its comments into the matrix and the TSI shall track its resolution for every comment in the matrix.

1.3.8.6 BAIFA will endeavor to expeditiously review submitted documents. The TSI shall plan for a minimum BAIFA review time of ten (10) working days for each review cycle. BAIFA requires the TSI to meet separate review times specified by Caltrans for civil plans.

1.3.8.7 The TSI shall update the relevant documents to address comments submitted by BAIFA and receive BAIFA written approval of the document prior to the TSI proceeding on any work related to the document, unless BAIFA provides written permission.

Submittal Approval

1.3.8.8 BAIFA's approval of documents shall not relieve or limit the TSI's responsibility to provide systems and services in full compliance with the TSI Agreement. If BAIFA requests corrections or improvements to submitted documents, the TSI shall resubmit the documentation and deliverables until such time as BAIFA accepts the document. Any need for re-submittal shall not be considered a delay caused by BAIFA.

1.3.8.9 Deviations from the requirements set forth in the Agreement, that may be contained within TSI submitted documents even though the document may be approved by BAIFA, shall not have the effect of modifying any requirement set forth in the Agreement. Only formal requests to BAIFA, from the TSI, for waivers or specification changes that are formally approved by BAIFA, shall modify the requirements set forth in the Agreement.

1.3.8.10 The TSI shall request written approval from BAIFA for deliverables and activities related to Qualifying Events for Milestone payments. BAIFA will endeavor to expeditiously perform final review and provide approvals requested by the TSI in writing. The TSI shall allow a minimum of ten (10) working days for final review and approval to be provided by BAIFA. BAIFA is not obligated to approve the request of any Milestone payment if the

document does not meet the RFP, design documents or the Agreement requirements.

1.4 Quality Management

1.4.1 The TSI is required to develop a quality management plan (QMP) covering all aspects of the project. The objective of the QMP is to place the responsibility for the quality of all services and performance related to the design of the system on the TSI, to facilitate the TSI's installation of the tolling system, and to allow BAIFA to fulfill its responsibilities of exercising due diligence in overseeing all areas of the completion of this project.

1.4.2 The TSI shall provide BAIFA with access to its internal documentation regarding its quality management process upon request. This shall include, but not be limited to:

- Defect reporting
- Configuration management reports
- Reports on quality monitoring of procedures

1.4.3 The TSI shall prepare a QMP for BAIFA's review and approval in accordance with Attachment B, Schedule and Project Milestone Dates. The QMP shall outline the TSI's internal quality control and quality assurance (QC and QA) procedures during all phases of the project.

Development of Quality Management Plan

1.4.4 The QMP shall ensure that all design documents are prepared in accordance with generally accepted practices for these types of services and the Agreement. Software design and development of quality practices for the project shall follow a standard for software quality assurance such as set by the Institute of Electrical and Electronic Engineers (IEEE) Std 730.1-1995, *Guide for Software Quality Assurance Plans.* Additionally, the QMP shall describe specific QC and QA procedures, including all required forms and checklists. QC and QA procedures shall be specified for preparing, verifying and checking all products and performance criteria related to this project to ensure that they are independently checked and back-checked in accordance with generally accepted practices for these types of services and the requirements of the Agreement. Additionally, the QMP shall describe and include the following:

1.4.4.1 For all design documents, a description of the level, frequency and method of checking that project requirements have been met.

1.4.4.2 Procedures for coordinating project services performed by different individuals in the same area, or in adjacent areas, or individuals performing related tasks, to ensure that conflicts, omissions or misalignments do not occur among design or installation documents or between the drawings and the specifications of any discipline. These procedures shall also include the

coordination of the review, approval, release, distribution and revision of documents involving such parties.

1.4.4.3 A description of procedures to: (1) ensure that TSI personnel are familiar with all the provisions of the Agreement concerning their respective responsibilities; (2) provide for the education, training and certification, as appropriate, of personnel performing activities affecting or assessing the quality of deliverables to assure that such personnel achieve and maintain reasonable proficiency; and (3) ensure that all Work is performed according to the QMP and generally accepted practices for these types of services and the Agreement.

1.4.4.4 Procedures for the documentation of meetings; the filing of design criteria, reports and notes, and supporting materials needed during the final design; and the specific responsibilities of personnel to satisfy these requirements. Documents shall be maintained, organized and indexed by the TSI and electronic and/or paper copies made available to BAIFA upon its request.

1.4.4.5 Procedures to control the handling, storage, shipping, cleaning and preservation of materials and equipment to prevent damage or deterioration.

1.4.4.6 Procedures to ensure that conditions adverse to quality, such as failures, malfunctions, deficiencies, defective material and equipment, and deviations are promptly identified and corrected. The procedures shall ensure that the cause of the condition is determined and corrective action taken to preclude repetition. Within a week of discovery, the TSI shall identify in writing to BAIFA the significant condition adverse to quality, the cause of the condition and the corrective action.

1.4.4.7 Measures to control the receipt and issuance of documents, such as instructions, procedures, training manuals and drawings, including changes thereto, which prescribe activities affecting quality. These measures shall ensure that approved documents, including authorized changes thereto, are reviewed for adequacy and approved for release by authorized personnel of the TSI, and are distributed to and used at the location where the prescribed activity is performed. Changes to documents shall be reviewed and approved by the same organizations that performed the original review and approval unless BAIFA consents, in writing, to another responsible organization and review structure.

1.4.4.8 Procedures and personnel to be used to assure that specified instrumentation is installed and monitored in accordance with applicable specifications.

1.4.4.9 Procedures that will be implemented to ensure that all software, Hardware, configuration files and project documentation are tracked, documented and managed in accordance with industry best practices. The TSI's document control system shall identify, categorize, track and manage all project plans, manuals and other documents under the TSI's control. The TSI's software version control system shall identify, categorize, track and manage all software for the ELN system. The TSI shall document revisions and track them using a system of version control and change control logs.

1.4.4.10 Procedures for software code releases for software changes.

1.4.5 TSI Quality Manager

TSI shall provide a quality manager (QM) who shall be responsible for quality oversight and the detailed review process for all aspects of the project including, but not limited to, software development and documentation. The QM shall not be involved with direct scheduling or production activities, and shall report directly to BAIFA and the TSI's management team. The QM shall ensure that the methods and procedures contained in the approved QMP are implemented and followed by the TSI staff. The individual designated as QM shall report to and coordinate all issues directly with TSI's project manager and BAIFA.

1.5 Project Communications

1.5.1 Project Communications Plan

1.5.1.1 The TSI shall provide a Project Communications Plan to be approved by BAIFA. The plan shall address all project communications, including formal and informal communications. The plan shall address, but not be limited to, the following: the contact list, TSI-provided conference line, open items list, punch list, meeting agendas, meeting minutes and schedule coordination with BAIFA, its consultants, the Civil Contractor(s), Caltrans and other external system stakeholders. The Project Communications Plan shall address all aspects of project coordination with BAIFA, its consultants, civil design and construction contractors, and other third parties including, but not limited to, the RCSC provider, Caltrans, the California Highway Patrol (CHP) and partnering agencies.

1.5.1.2 An approved BAIFA representative shall be copied on or apprised of all communications with third parties regarding the project. The plan shall detail TSI contact information and communication escalation plans in the event that the main contact is unavailable or unresponsive.

1.5.2 Project Meetings

1.5.2.1 The TSI shall develop all meeting agendas for standing project meetings and meetings called by the TSI. Agendas shall be sent to invitees a minimum of one (1) working day prior to meetings.

1.5.2.2 The TSI shall record notes of each meeting and distribute copies of the draft notes to attendees within five (5) working days of the meeting for review and comment. The notes shall include a summary of issues discussed as well as decision and action items. At a minimum, all meeting notes shall contain a complete list of attendees, descriptions of issues discussed, any decisions made, direction given, remaining open issues, and action items. For all appropriate items such as decisions or action items, the notes shall identify the party responsible for that item. Internal meetings between the TSI's team members are excluded from this requirement.

1.5.3 Weekly Project Status Meetings

From NTP through the final implementation Milestone of System Acceptance, the TSI shall meet weekly with BAIFA, either in person or by telephone, to discuss project status.

1.5.4 Monthly Progress Reports

Commencing within the first thirty (30) Days after issuance of NTP, the TSI shall submit a monthly progress report. The monthly progress reports shall be submitted by the fifth working day of each month for the preceding month.

The monthly progress reports shall include the following:

1.5.4.1 Progress for the prior month for all project activities.

1.5.4.2 Actual start and actual finish dates of Work, percentage complete, and Days remaining for Work in-progress.

1.5.4.3 All potential delays and problems, actions the TSI is taking to address the delays or problems, and the estimated effect on Project Schedule and overall completion.

1.5.4.4 Critical items graphical report for each critical path, sorted by activity start date.

1.5.4.5 Electronic copies of the updated Project Schedule in both native and PDF formats.

1.5.4.6 Progress on activities requiring coordination with the Civil Contractor(s) and communications contractor.

1.5.4.7 Deliverables scheduled for submittal in the next reporting period.

1.5.4.8 30-day look-ahead report on all BAIFA approvals needed.

BAIFA will use these updates to manage its activities, be responsive to TSI's Project Schedule, and measure the TSI's performance with respect to its plan for the project.

1.6 Subcontractor Management Plan

The TSI shall deliver a Subcontractor Management Plan for BAIFA's approval. The TSI shall update the initial plan that was submitted as part of the TSI's proposal /best and final offer if necessary, and provide updates when BAIFA approves a change in subcontractors. The Subcontractor Management Plan shall describe the TSI's plans for managing its subcontractors to deliver a project that meets the requirements of the Work at the required quality, cost, and schedule. At a minimum, the Subcontractor Management Plan shall:

1.6.1 Indicate which areas of the ELN project each subcontractor will help the TSI to implement.

1.6.2 Indicate the percent of that Work that this subcontractor will perform and the number of full-time employees the subcontractor will use on the project.

1.6.3 Identify the Project Manager for that subcontractor and the size of its team.

1.6.4 Detail any agreements between the TSI and the subcontractor regarding the provision of equipment, machinery, working space, test environments, or other matters related to the ability of the team to complete the ELN project.

1.6.5 Describe how the TSI will ensure that its subcontractors meet relevant project requirements including the quality of subcontractor work.

1.7 Safety Plan

1.7.1 The TSI shall develop a comprehensive Safety Plan for the project, which will be submitted to BAIFA for review, comment and approval.

1.7.2 The Safety Plan should describe the procedures that will be instituted both during system implementation/deployment and during system maintenance activities to ensure personal safety and compliance with all applicable state and federal laws, rules and regulations, and legislation including, but not limited to, that established by: the Occupational Safety and Health Administration, National Electrical Contractors Association , Federal Highways Administration (FHWA), the Manual on Uniform Traffic Control Devices (MUTCD), and Caltrans. Prior to entrance to any work area, the TSI will ensure that all personnel working within the express lane TCS work areas are trained on the safety program and will be responsible at all times for the safety of all TSI personnel.

1.8 Project Execution

The TSI shall execute the project in strict accordance with the PMP and other plans developed pursuant to the Agreement. Throughout the project, the TSI shall be responsible for continually managing and updating the comprehensive PMP and other planning documents and communications tools.

1.8.1 Schedule Delays

1.8.1.1 The TSI shall identify and promptly report to BAIFA all Project Schedule and progress delays during the execution of the project.

1.8.1.2 The TSI shall alert BAIFA a minimum of thirty (30) Days prior to a Milestone if the TSI knows or should have known about a delay in meeting the Guaranteed Completion Date of a Milestone.

1.8.1.3 In the event of any schedule delay, the TSI shall take appropriate action to develop a Recovery Schedule. The TSI shall submit a Recovery Schedule with the monthly schedule update(s) immediately following the identification of a Project Schedule delay. Recovery Schedules do not release the TSI from liability for delayed Milestone delivery.

1.8.2 Schedule Revisions

1.8.2.1 The TSI shall submit proposed changes to the Project Schedule, along with the reason for the proposed changes, for BAIFA approval as it becomes necessary to modify the Project Schedule to reflect changes to the WBS, Work sequences, or to further subdivide the activities.

1.8.2.2 Until BAIFA approves any revision in writing, all Project Schedule submittals shall be tracked against the previously approved Project Schedule baseline. Once the revised Project Schedule is approved by BAIFA, it shall become the Project Schedule of record, a baseline shall be created, and it shall be used as the basis for the subsequent monthly Project Schedule updates.

1.8.3 Changes in Key Personnel

1.8.3.1 Proposed changes to key project personnel as submitted with the TSI's proposal require prior written approval from BAIFA. BAIFA shall have the right to reject, in its sole discretion, any proposed replacement.

1.8.3.2 The TSI shall notify BAIFA at least thirty (30) Days in advance of replacing any key project personnel and shall submit the names and qualifications of the proposed replacement(s) to BAIFA for prior written approval.

1.9 Project Closure

1.9.1 The TSI shall conduct a project closure meeting(s) with BAIFA to review project records, ensure that all signed acceptance deliverables are complete and properly filed, and that the complete project record fully supports contract and payment acceptance.

1.9.2 At BAIFA's request and schedule, the TSI shall conduct a work session to identify and document the strengths, weaknesses, and lessons learned identified during the project and to develop suggested strategies for consideration during future projects.

2. Business Rules and System Requirements Refinement

2.1 General

The TSI shall work collaboratively with BAIFA and BAIFA's project partners to refine the business rules and requirements for system functionality. All proposed refinements are subject to BAIFA's final approval.

2.2 Requirements Refinement Workshops

2.2.1 The TSI shall collaboratively facilitate workshops with BAIFA and other project partners designated by BAIFA to review and discuss business rules and system requirements and the TSI's proposed refinements.

2.2.2 The TSI shall provide documentation to demonstrate how the refinement or optimization of a requirement meets BAIFA's business objectives or conceptual intent. The TSI shall clearly identify the implications that any proposed refinement has on cost, performance, risk, schedule, system constraints or agility, and long-term maintenance and operations.

2.2.3 The TSI shall also participate in separate meetings with the Regional Customer Service Center (RCSC), Caltrans and 511 to determine the requirements for their respective Interface Control Documents (ICD).

2.3 Requirements Traceability Matrix

2.3.1 The TSI shall refine the business rules and develop a Requirements Traceability Matrix (RTM), using Appendix 1, Scope of Work as a starting point. The Requirements Traceability Matrix shall have columns where the TSI will tie those requirements to other key documents including the System Design Document (SDD) and test plans.

2.3.2 The TSI shall submit its proposed tool for creating the RTM and the RTM format to BAIFA and obtain BAIFA approval prior to creating the initial RTM. The RTM tool shall not require BAIFA to purchase licenses in order to read or update the RTM in its original format.

2.3.3 The TSI shall continuously maintain and update the Requirements Traceability Matrix throughout the life of the project. It shall include only requirements that BAIFA has dictated or agreed to. The TSI shall provide the first draft of the RTM by the Project Initiation Conference, where it will be reviewed and discussed. The TSI shall not incorporate any changes into the RTM without written approval from BAIFA. The RTM shall show the origin of requirements, any changes to requirements, and the source of approval for those changes.

2.3.4 The RTM shall be used to verify compliance throughout system design, development, installation, testing, and deployment phases, and into ongoing maintenance and operations. The TSI shall be responsible for the compliance of their system and all

supporting activities and deliverables with the Requirements Traceability Matrix throughout the entire life cycle of the project.

2.4 Security Plan

2.4.1 The TSI shall provide a Security Plan that describes in detail the resources, processes and documentation to ensure security of project and customer data, inventory, spares, equipment installed in the lanes, and other project assets in accordance with Attachment B, Schedule and Project Milestone Dates.

2.4.2 The Security Plan shall describe Information security including lifecycle management and processes to maintain the confidentiality, integrity and security of information assets and resources. The Security Plan shall detail plans to ensure compliance with federal, state and local regulations and with the security requirements set forth in the Agreement (Attachment G, Special Conditions Regarding Personally Identifiable Information).

2.4.3 The Security Plan shall provide plans for preventing the loss of copper and aluminum from any TSI installed equipment during installation and operations. The Security Plan shall also detail the TSI's response to the occurrence of such a theft.

2.4.4 The TSI shall use the final approved Security Plan to drive the development of other required project documentation such as the SDD and the Cutover and Installation Plan.

3. Design & Development Planning

3.1 Updated System Design Work Plan

The TSI shall update the System Design Work Plan, submitted as a part of their project proposal, to reflect any new information learned during the project planning and system requirements refinement process. The TSI shall submit this updated System Design Work Plan for BAIFA approval according to Attachment B, Schedule and Project Milestone Dates.

3.2 Software Development Plan

3.2.1 The Software Development Plan (SDP) shall describe the software lifecycle approach that emphasizes the necessary interactions between various system development disciplines, i.e., software development; system engineering; testing; software quality assurance (SQA); configuration management; documentation; project management, and software maintenance.

3.2.2 The SDP shall also include detailed information on the technical approach, problem reporting and tracking process, software configuration, change management and version control, regression testing, and software release and verification. The SDP shall also include the process utilized by the TSI to document software source code, code development, unit testing, quality control, and code release.

3.2.3 All of the above, and any other areas identified by the TSI or BAIFA to be included in the SDP, shall be coordinated with the overall Project Schedule to ensure completion of all system development activities within specified timeframes.

4. System Design

4.1 General

4.1.1 System design efforts may proceed in parallel with requirements refinement, but shall be subject to change if TSI assumptions place the design in conflict with the Requirements Traceability Matrix or final Business Rules.

4.1.2 System design shall result in a final, formal System Design Document (SDD) and a Disaster Recovery Plan. The TSI shall design and develop the system to meet or exceed all technical and operational requirements set forth in the Agreement and associated documents. The TSI shall coordinate with BAIFA throughout the requirements and design process.

4.1.3 The TSI shall work with the Civil Contractor(s), BAIFA, and other relevant parties to ensure that all areas of the design coordinate with other plans and procurements related to the project including, but not limited to, all electrical power and communications, all necessary civil infrastructure, and provision of racks, Uninterruptable Power Supply (UPS), outlets, and racks at the Host locations.

4.1.4 The TSI shall subcontract with the AVI equipment manufacturer to ensure that the design and planned installation of that equipment will meet AVI performance standards in all Express Lanes and for the manufacturer to assist with the actual installation, tuning and testing of all the AVI subsystem. If the TSI is the manufacturer of the AVI subsystem, the TSI will not be required to subcontract but will still be required to meet AVI performance standards in all Express Lanes.

4.1.5 The TSI shall obtain certification of its AVI subsystem through the OmniAir Certification Services' ISO 18000-6C Certification Program prior to the start of the Preliminary Design Review. The TSI shall deliver both the certificate and related certification report to BAIFA as proof of this certification.

4.1.6 The TSI design documentation shall clearly trace back to the final Business Rules and the RTM.

4.2 System Design Document

The System Design Document shall address all areas of the ELN system design, be tied to the traceability matrix, and fully describe the system, including, but not limited to:

- System overview (high level system description)
- System architecture (Hardware and software)
- Database design (data elements and definitions)

- Equipment functions and installations
- Alarms and maintenance management systems
- Data processing logic, data flows and storage
- System and user interfaces
- User access and security
- Data security and integrity
- Reports
- Financial functionality and exception processing
- Trip Transaction creation and pricing algorithm
- System administration
- Communications

The SDD shall detail the realization of the entire system including equipment, procedures, operating scenarios, exceptions, schematics, file structure, data element, message structure, integration, and database definition. For communications, the design detail shall include plan layouts, equipment, procedures and schematics. The SDD shall include an updated bill of materials, updated Software List, and Hardware cut sheets. The Hardware design shall identify how the Hardware components meet requirements, will tabulate power and environmental requirements, installation requirements, servicing requirements, as well as how the function of the Hardware component will be monitored and tested by the system. The SDD shall clearly delineate anything provided by the TSI from that to be provided by other entities such as BAIFA or the Civil Contractor(s).

The above description is not complete and the TSI shall be responsible for including all aspects of the system in the SDD, whether or not that aspect has been included on the above list.

4.3 Preliminary Design Document

4.3.1 Meetings and discussions necessary to answer questions and clarify issues shall be held as needed during the development of the Preliminary Design Document (PDD). The final draft PDD structure shall serve as the basic agenda for a document walkthrough to be carried out during the preliminary design review (PDR) meeting.

4.3.2 Key Design Areas

The TSI shall divide their approach to system design into five key design areas as described below. The TSI shall schedule design reviews, conference calls and meetings specifically targeted to those five key areas. The key areas defined for the project are described as follows:

4.3.2.1 Lane Level Systems

- Vehicle detection and separation
- Automatic Vehicle Identification (AVI) (vehicle association, antenna position and configuration, tuning, preventing cross lane reads, etc.)
- Vehicle processing in exception cases (two tags, tag with no vehicle, cross lane reads, buffered tags, etc)
- Violation Enforcement System

- Variable Toll Message Signs (VTMS) operations and failure logic
- Traffic Monitoring System (TMS)
- Data collection and storage in local servers
- Messages between controllers and Host
- Prevention of theft or vandalism of lane equipment
- Functionalities during equipment failures

4.3.2.2 System Architecture

- Requirements and assumptions regarding location of all equipment including communications within a Corridor
- Sample layout of equipment, communications and power for type of equipment location
- Preliminary architecture for each type of Read Point
- Host architecture including physical and virtualized architecture
- Host location requirements
- System security and access control
- Data storage, access and recovery
- Back up and Disaster Recovery/business continuity
- End to end data flows including both internal and external interfaces
- System administration
- Processing capacity
- Communication capacity

4.3.2.3 Host Level

- RCSC, 511 and Caltrans ICDs
- Financial and audit applications
- Reports
- User interfaces including configuration parameters
- Processing of transactions sent to RCSC and reconciling information from the RCSC
- Transaction research
- CHP web portal
- Toll rate setting including Dynamic Pricing algorithm
- Trip Transaction Building
- Real time monitoring screens
- Incident reporting
- Toll rate overrides and correction

4.3.2.4 System Wide

- Automatic License Plate Recognition (ALPR)

- Lane Modes
- Maintenance Online Management System (MOMS) including alerts and alarms

4.3.2.5 Communications

- Communications network architecture
- Communication equipment functions and installations
- Network security, protection and access
- Management, device, and routing virtual local area network configuration
- Internet protocol (IP) addressing scheme, including IP subnets, and masks if applicable
- Proposed configuration and guidelines for specific port assignments on each of the Layer 2 and 3 devices
- Proposed configuration and guidelines for 802.1p class of service (CoS) queue assignments
- Redundancy, availability, and bandwidth usage

4.3.3 The TSI shall place designs for these five key areas into a Preliminary Design Document, which shall be a preliminary draft of the SDD. This document shall form the basis of the preliminary design review. The TSI shall submit the final draft PDD for review by BAIFA and its designees 15 working days in advance of the preliminary design review. BAIFA shall review the PDD and provide comments five working days prior to the preliminary design review.

4.3.4 The preliminary design review (PDR) shall be a complete and detailed review that will assist in the detection and elimination of inconsistencies and other problems. The PDR shall be a series of interactive workshops led by the TSI, with formal presentations to BAIFA covering each critical design area in the preliminary design. The PDR shall also cover high-level plans for development of the complete ELN. The TSI staff with detailed expertise in the major systems and subsystems shall attend the PDR to enable technical discussion. The TSI shall provide detailed resolution for BAIFA comments on each critical design area prior to the start of the relevant interactive workshop.

4.3.5 Within 10 working days after the end of the PDR, the TSI shall provide final comment resolutions, any additional required changes or additions to the SDD including an updated RTM, meeting minutes, and any outstanding action items. If the outcome of the PDR has any impact on the schedule, the TSI shall provide a proposed revised schedule as described in Section 1.8.1. Upon receipt of this documentation, BAIFA shall determine whether to approve the PDD. BAIFA may choose to approve the design for the five key areas separately.

4.4 Critical Design Review

4.4.1 The TSI shall make revisions to the SDD in accordance with the approved results of the PDR. The updated SDD shall be reviewed during the critical design review (CDR). The critical design review shall be a series of interactive workshops led by the TSI, with formal presentations to BAIFA covering each critical design area in the preliminary design. The CDR shall also cover detailed plans for development of the complete ELN. The TSI staff with detailed expertise in the major systems and subsystems shall attend the CDR to enable technical discussion. The TSI shall provide detailed resolution for BAIFA comments on each critical design area prior to the start of the relevant interactive workshop.

4.4.2 The TSI shall submit the updated SDD for review by BAIFA and its designees in advance of the CDR at least 20 working days prior to the CDR. BAIFA shall review the PDD and provide comments five working days prior to the preliminary design review.

4.4.3 Within 10 working days after the end of the CDR, the TSI shall provide final comment resolutions, any additional required changes or additions to the SDD, an updated RTM, meeting minutes, and any outstanding action items. If the outcome of the CDR has any impact on the schedule, the TSI shall provide a proposed revised schedule as described in Section 1.8.1.

4.4.4 The TSI shall submit a final SDD, which includes the updated RTM, reflecting the outcome of the CDR for BAIFA approval in accordance with Attachment B, Schedule and Project Milestone Dates. The TSI shall obtain BAIFA written approval of the final SDD prior to the start of system development.

4.5 Bill of Materials

4.5.1 The TSI shall provide Bill of Materials Tracking Report to track the bill of materials as approved in the final SDD. The report shall:

4.5.1.1 Provide monthly updates for materials that have been ordered, delivered and paid for by the TSI.

4.5.1.2 Indicate any deviations from the bill of materials as listed in the approved SDD.

4.5.2 The Bill of Materials Tracking Report shall be delivered with the monthly schedule and in accordance with Attachment B, Schedule and Project Milestone Dates.

5. Development

Development efforts may proceed in parallel with design at the TSI's risk, but shall be subject to change if TSI assumptions place the development in conflict with the SDD or final Business Rules.

Development includes application software, Hardware design, report design, training plans, system interfaces, user manuals and final electrical/mechanical installations.

5.1 Functional Demonstration Plan

TSI shall deliver a Functional Demonstration Plan that details the overall approach to conducting reviews and demonstrations of the system and the component functions listed below. The Functional Demonstration Plan will undergo the same round of submissions, review, updates and approval as required in Section 1.3.6.

The demonstrations shall be scheduled to allow BAIFA to provide feedback during the development process. The TSI shall schedule between three and six demonstrations, each covering several of the items listed below. These demonstrations shall take place over the course of the development phase. These demonstrations shall start at least four months prior to the scheduled factory acceptance test (FAT) and must be finished 30 Days prior to the scheduled FAT. The TSI shall set-up, conduct, and document the results of demonstrations including, but not limited to:

- Lane Transaction creation
- Violation Enforcement System (VES)/ ALPR
- Enforcement beacon
- Tagged and Image Based Trip Transaction creation
- Dynamic Pricing algorithm
- Toll rate test environment
- Operations in the event of equipment failure
- Exception processing
- Accounting and audit screens
- Reporting user interface
- Processes related to the RCSC interface
- Communications between Zone servers and Host
- Research screens
- CHP web portal
- Traffic monitoring screens and reports

6. Disaster Recovery Plan

During the time when the TSI is developing the SDD, the TSI shall also create a Disaster Recovery Plan. The TSI shall work with BAIFA to ensure that this Disaster Recovery Plan integrates with BAIFA's Operational Disaster Recovery Plans. This Disaster Recovery Plan shall undergo the same review process as the SDD and shall, at a minimum, cover the following:

- Risk assessment and identification of critical physical and information assets
- Communication between production system and secondary Host site including plans and steps for recovery, re-synchronization of data and configurations, resumption of system functions
- Plans for the system to recover from a variety of scenarios including, but not limited to:
    a. Loss of the main Host site

b. Communications severed between lanes, main Host site, roadway operation centers, or RCSC for a significant period of time
c. Critical man-made security incident
d. Recovery of critical assets identified in risk assessment

- Plans for regular backups of system data and appropriate storage of back up data in case of fire, theft, natural disaster, or technical difficulty
- Ensuring that the secondary Host site is operational 24/7
- Business continuity procedures, personnel roles and communication plans that shall be implemented to allow continuation of ELN operations in case of various scenarios. Procedures shall include contingencies for staff unavailability
- Procedures for post-event analysis, reporting and recommendation of changes to procedures or the TCS itself to improve recovery in the future

7. Civil Coordination

7.1 General

7.1.1 The TSI, Civil Contractor(s), Bay Area Toll Authority (BATA)/BAIFA Backhaul provider, and utility companies shall have various responsibilities pertaining to the installation activities. *Reference 2*, Diagrams, Drawings and Schematics, contains depictions of civil infrastructure, power and communications conduit, cabling, and equipment installation responsibilities between parties**.**

7.1.2 The TSI shall include in the Master Installation and Cutover Plan and each Corridor Specific Installation and Cutover Plan, an action plan to coordinate sequencing of Work with Civil Contractor(s) and utility providers on each Corridor.

7.1.3 The TSI shall coordinate with the Civil Contractor(s) to establish electrical power and communication/data service requirements for each roadside TCS equipment location. This shall include coordination with the Civil Contractor(s) responsible for working with the utility company and making application for the necessary electrical services for the roadside TCS equipment locations. Pacific Gas and Electric (PG&E) will provide power to a specific agreed upon point at each roadside TCS equipment location and the TSI shall be responsible from that demark to the point of use. All installation work shall be in accordance with the latest adopted version of the National Electric Code (NEC).

7.1.4 The TSI shall be responsible for coordinating with BAIFA staff for backhaul network access, data center access and any resulting connectivity.

7.1.5 The TSI shall specify, furnish and install all roadside cabinets onto foundations or mounting surfaces to be provided by the Civil Contractor(s) in accordance with TSI requirements provided during the civil design.

7.1.6 The TSI shall coordinate with BAIFA and the Civil Contractor(s) on the design and installation of VTMS light emitting diode (LED) panels onto VTMS sign structures.

7.1.6.1 The TSI shall review plans, specifications, and shop drawings related to the mounting of the TSI's VTMS LED panels onto VTMS sign structures and static signs.

7.1.6.2 The TSI, BAIFA, and I-680 Civil Contractor(s) shall coordinate on the construction of a mock-up of the VTMS LED panels onto a VTMS sign structure and static sign to demonstrate the installation process and mounting design.

7.1.6.3 The TSI shall furnish and install the VTMS LED panel for the mock-up and shall be complete in all respects.

7.1.6.4 Location and orientation of the mock-up along the I-680 Corridor shall be coordinated between the TSI and the Civil Contractor(s) and approved by BAIFA.

7.1.6.5 Timing of the mock-up construction shall be in accordance with Attachment B, Schedule and Project Milestone Dates.

7.1.6.6 Upon completion of the mock-up, the TSI shall provide a "VTMS Installation" report detailing the installation and any revisions needed to the mounting design and procedures.

7.1.6.7 The TSI shall repurpose the VTMS LED panels once BAIFA provides approval.

7.1.6.8 The TSI shall coordinate with the Civil Contractor(s) for the installation of VTMS LED panels onto the VTMS sign structures and static sign panels provided by the Civil Contractor(s) based on the findings of the "VTMS Installation" report. The TSI shall install the VTMS LED panels onto the Civil Contractor's VTMS sign structure before the Civil Contractor(s) installs the whole assembly over the roadway.

7.1.7 The TSI, BAIFA, and Civil Contractor(s) shall coordinate on the unveiling of all roadway signage, including VTMS, in preparation for go-live.

7.1.8 The TSI shall take all necessary precautions to see that no damage is done to any existing structures due to their operations. In the event that any structure is damaged due to TSI activity, such damage shall be repaired immediately at the TSI's expense and to the satisfaction of BAIFA in coordination with the Civil Contractor(s).

7.2 Reviewing of Civil Design

7.2.1 The TSI shall meet with BAIFA and its representatives to discuss civil plans, specifications, and contract terms to ensure the TSI's complete understanding of the proposed civil work.

7.2.2 The TSI shall provide written comments on the plans, specifications, and contract terms that address any changes to the civil design and documents necessary to allow the TSI to meet or improve functional requirements, performance requirements, schedule, and/or reduce risk.

7.2.3 The TSI shall incorporate the 65% civil design and the later iterations of the civil design in the development of the System Design Document.

7.2.4 The TSI shall have 20 working days to review and provide written comments on 65%, 95%, and any other sets of plans and specifications for each Express Lane Network Corridor.

7.2.5 The TSI shall be responsible for reviewing within ten (10) working days shop drawings for elements affecting the TSI's tolling solution submitted by the Civil Contractor(s), other Contractors, and utility companies'.

7.3 Review Cycle on TSI Civil Plans

The TSI shall allow for two rounds, each 45 Days, for toll system civil elements that will need Caltrans design and shop drawing approval. Toll system civil elements shall be identified during final design and approved by BAIFA and Caltrans and shall include, but not be limited to, VTMS LED panels, equipment mounting Hardware, pavement epoxies/sealants, equipment grounding, and mounting poles.

7.4 Civil Coordination Meetings

The TSI shall participate in regular meetings with the civil design and construction team and provide comments on later iterations of the civil design and construction installation work. The TSI shall use the knowledge gained from these meetings and design reviews to update design documents and installation plans, as necessary.

7.5 Civil Site Acceptance Checklist

7.5.1 The TSI shall be responsible for creating and using a Civil Site Acceptance Checklist for all civil infrastructure elements at toll equipment locations where the TSI will install TCS equipment. The checklist shall include but not be limited to: gantry, controller cabinet pads, Host server room, conduits, pull boxes, pull ropes, closed-circuit television (CCTV) poles, roadway pavement, and electrical power.

7.5.2 The TSI shall submit a BAIFA approved Civil Site Acceptance Checklist with the Master Installation and Cutover Plan.

7.5.3 The TSI shall be responsible for conducting a field inspection at each toll equipment location at the same time BAIFA or a BAIFA representative conducts their inspection.

7.5.3.1 For each toll equipment location, the TSI shall submit completed Civil Site Acceptance Checklist, initialing every element inspected. The TSI shall immediately provide written notice to BAIFA of any deficiency found during the inspection, including identification of any items that would prevent the TSI's takeover of the site. The TSI shall not take over the site until the Civil Contractor(s) resolves such items and the TSI completes the Civil Site Acceptance Checklist.

7.5.3.2 Upon submission of the completed Civil Site Acceptance Checklist, the TSI shall be able to commence installation work at the toll equipment location.

7.6 Network Site Acceptance Checklist

7.6.1 The TSI shall be responsible for creating and using a Network Site Acceptance Checklist for all network interface details at locations where the Express Lane Toll System network will be connected to BAIFA, BATA or Caltrans networks. The checklist shall include, but not be limited to: physical and logical connection details; type and model of equipment being interfaced to; interface cable media type, connector type, duplex and speed; protocols necessary for communications, including routing and switching protocols; VLAN(s), IP addresses, network and port address translations, if used; encryption details, if required; location details, including address, room number, cabinet, and rack ID; point-of-contact(s), site access requirements and maintenance windows.

7.6.2 The TSI shall submit a BAIFA approved Network Site Acceptance Checklist with the Master Installation and Cutover Plan.

7.6.3 The TSI shall be responsible for conducting a network inspection at each toll equipment location at the same time BAIFA or a BAIFA representative conducts their inspection.

7.6.3.1 For each toll equipment location, the TSI shall submit a completed Network Site Acceptance Checklist, initialing every element inspected. The TSI shall immediately provide written notice to BAIFA of any deficiency found during the inspection, including identification of any items that would prevent the TSI's takeover of the site. The TSI shall not take over the site until the Network Contractor resolves such items and the TSI completes the Network Site Acceptance Checklist.

7.6.3.2 Upon submission of the completed Network Site Acceptance Checklist, the TSI shall be able to commence installation work at the toll equipment location.

8. Traffic Control

8.1 General

8.1.1 The TSI shall be responsible for all maintenance of traffic (MOT) during TCS implementation and TCS maintenance activities for the duration of the Agreement.

8.1.2 The TSI shall comply with the Caltrans latest Standard Plans, Specifications, the Caltrans Encroachment Permit Provisions for each Corridor, Caltrans Traffic Manual, and FHWA MUTCD. The TSI will be responsible for coordinating the review of the traffic control and sequencing plans with BAIFA, Caltrans, and applicable governmental entities.

8.1.3 The TSI shall obtain Caltrans rider encroachment permits for each Corridor, based on BAIFA's encroachment permits. The TSI shall follow the conditions stipulated in the encroachment permits.

8.1.4 The TSI shall follow lane closure notification procedure based on the permit requirements furnished by Caltrans and any additional requirements established by BAIFA. The TSI shall coordinate the maintenance of traffic required for installation with BAIFA, Caltrans, and the Civil Contractor(s).

8.1.4.1 Requests shall be made in coordination with BAIFA and the Civil Contractor(s) for each installation to reduce the number of MOT requests and limiting the lane closure times.

8.1.4.2 All equipment required at Read Points, as provided and installed by the TSI, shall be ordered and sequenced to minimize any delays that may be caused by unavailable equipment during coordinated scheduled MOT events.

8.1.4.3 The TSI shall notify BAIFA and Caltrans of any lane closure at a minimum seven (7) Days prior to the closure being set.

8.1.4.4 The TSI shall use the Caltrans Lane Closure System for MOT requests.

8.1.5 The TSI shall ensure that all personnel working on the BAIFA Express Lanes TCS work areas are fully trained and comply with the approved Traffic Control Plans (TCP).

8.1.6 The TSI shall assist and coordinate with BAIFA on requests for CHP assistance during closures as part of the Construction Zone Enhanced Enforcement Program (COZEEP) or Maintenance Zone Enhanced Enforcement Program (MAZEEP).

8.1.7 The TSI shall be responsible for penalties shown in Attachment C, Performance Requirements and Penalties.

8.2 Traffic Control Plan(s)

8.2.1 The TSI shall develop a TCP for the project, which will be submitted to BAIFA and Caltrans for review, comment and approval 60 Days before any field installation activity commences and updated as directed by Caltrans and BAIFA.

8.2.2 The TSI must update the TCP during implementation. Any changes must be reviewed and approved by BAIFA and Caltrans prior to the TSI implementing such changes.

8.2.3 The TCP shall reflect traffic control and sequencing plans that will minimize impacts to existing traffic conditions on all roadways open to traffic to ensure traffic safety and continued efficient traffic flow.

8.3 Lane Closures

8.3.1 The TSI shall be subject to Caltrans rules for all lane closures. The following requirements reflect Caltrans' current rules regarding lane closures. These rules are subject to change in the future and the TSI shall follow the Caltrans rules in effect at the time of any work in the lanes.

8.3.2 Lane closures, which include ramp and shoulder closures, will be prohibited between the hours of 5:00 am and 8:00 pm Monday through Sunday. Shoulder closures on the right shoulder may be allowed between 5:00 am and 8:00 pm Monday through Sunday. Changes in these hourly requirements require written approval by Caltrans and BAIFA.

8.3.3 For local street closures, the TSI shall be subjected to restrictions of the locality..

8.3.4 As part of the Corridor Specific Installation and Cutover plans, the TSI shall submit lane closure charts for review and approval by Caltrans and BAIFA for each specific Corridor. The full width of the travel way shall be open for use by the public as indicated in the lane closure charts developed by the TSI.

8.3.5 The full width of traveled way shall be open for use by public traffic as shown in the table "Lane Closure Restriction for Designated Legal Holidays and Special Days" included in this section. Designated legal holidays are: January 1st, the third Monday in February, the last Monday in May, July 4th, the first Monday in September, November 11th, Thanksgiving Day, and December 25th. When a designated legal holiday falls on a Sunday, the following Monday shall be a designated legal holiday. When November 11th falls on a Saturday, the preceding Friday shall be a designated legal holiday.

Lane Closure Restriction for Designated Legal Holidays and Special Days										
Thu	Fri	Sat	Sun	Mon	Tues	Wed	Thu	Fri	Sat	Sun
x	H xx	xx	xx							
	SD xx									
x	xx	H xx	xx							
		SD xx								
	x	xx	H xx	xx						
			SD xx							
	x	xx	xx	H xx	xxx					
	x	xx	xx	SD xx	xxx					
				x	H xx					
				x	SD xx					
					x	H xx				
						SD xx				
						x	H xx	xx	xx	xx
							SD xx			
Legends:										
	Refer to lane closure charts									
x	The full width of the traveled way shall be open for use by public traffic after 5 AM.									
xx	The full width of the traveled way shall be open for use by public traffic.									
xxx	The full width of the traveled way shall be open for use by public traffic until 8 PM.									
H	Designated Legal Holiday									
SD	Special Day									

8.3.6 The TSI shall address all lane-closing procedures in the TCP. TSI shall follow BAIFA and Caltrans procedures for lane access, lane closure notification requirements, lane closure procedures, traffic protection rules and procedures, and all other appropriate safety requirements.

8.3.7 In the event of an emergency as defined by BAIFA, the TSI shall immediately respond to direction from BAIFA, Caltrans, or the CHP.

8.4 Traffic Control Coordinator

8.4.1 The TSI shall provide a full-time traffic control coordinator throughout the duration of implementation. The traffic control coordinator shall cooperate with BAIFA, Caltrans and other project contractors.

8.4.2 The TSI shall provide BAIFA with the name of the TSI's traffic control coordinator along with a 24-hour phone number where the traffic control coordinator or designee can be reached at all times.

9. Installation and Cutover

The installation and cutover of the ELN system includes planning, testing, training, installation and operational implementation from the start of preparation for installation to final cutover of the last lane to production. To successfully implement the installation and cutover of the ELN system, the TSI shall cooperate and coordinate with BAIFA, Caltrans, and BAIFA's Civil Contractor(s), CHP, and with BAIFA staff and/or consultants overseeing construction, installation and testing.

The TSI shall create and implement Installation and Cutover plans that deliver a system in accordance with the final SDD and Disaster Recovery Plan. The TSI shall deliver these plans on the schedule shown in Attachment B, Schedule and Project Milestone Dates allowing time for the required reviews, updates, and BAIFA approval as required for all documentation in the project.

Equipment ordering and installation may proceed in parallel with design, but shall be subject to change until the TSI's solution passes Factory Acceptance Testing.

9.1 Master Installation and Cutover Plan

9.1.1 The TSI shall prepare and submit a complete and comprehensive Master Installation and Cutover Plan that addresses system implementation from a system-wide level down to individual Read Points. The TSI shall provide drafts of the Master Installation and Cutover Plan to allow for reviews, revisions, and approval of the plan as required for all documentation in the project.

9.1.2 The Master Installation and Cutover Plan shall address, but not be limited to, the following:

- Prerequisites for installation such as civil, power, and communications requirements
- Documentation delivery including drawings and plans
- Installation and Cutover schedule
- Duties and responsibilities of all parties
- Separation of test data from production data
- System interfaces
- Coordination of testing activities during cutover

- Training plan for BAIFA staff and staff from other related entities such as CHP and RCSC
- Safety planning
- AVI installation procedures including power and read zone measurements and initial tuning
- Installation sequencing and procedures, including civil checklist
- Integration of new network elements into BAIFA's existing network, including the Backhaul network
- Lane closure preparation and traffic control
- Tolling Commencement

9.1.3 The TSI is responsible for determining its staging requirements and for providing them, including any and all facilities, utilities, security, and improvements required.

9.1.4 The Master Installation and Cutover Plan shall include plans for coordinating with BAIFA, the Civil Contractor(s), Caltrans, and other entities necessary for successful installation. The TSI shall include the need for planned outages of communication networks or other existing BAIFA assets. The TSI shall include back-out plans for instances when cutovers do not meet requirements.

9.2 Corridor Specific Installation and Cutover Plans

9.2.1 The TSI shall prepare and submit Corridor Specific Installation and Cutover Plans for each Corridor's installation. The TSI shall deliver these plans in accordance with the schedule in Attachment B, Schedule and Project Milestone Dates, allowing time for the rounds of draft submissions, reviews, updates and approvals as required for all documentation in the project.

9.2.2 These Corridor-specific Installation and Cutover Plans shall follow the same basic format and be consistent with the Master Installation and Cutovers Plan but shall provide more Corridor-specific detail including, but not limited to, the following:

- Prerequisites for installation from the TSI, from BAIFA, and from the Civil Contractor(s)
- A detailed Installation and Cutover schedule
- Coordination of testing activities during installation
- Safety and traffic control planning
- Installation sequences and procedures, including civil checklist
- Tolling Commencement

9.2.3 If the TSI's Corridor Specific Installation Plan deviates from the master plan, the TSI shall indicate such deviations from the Master Installation and Cutover Plan and obtain BAIFA approval for those deviations in advance of submitting a Corridor Specific Installation Plan. The TSI shall update the Master Installation and Cutover Plan to reflect these approved changes.

9.3 Installation Preparation

Installation preparation will occur in parallel with other systems and civil activities. For each Corridor, the TSI shall:

9.3.1 Obtain the necessary rider encroachment permits from Caltrans and other regulatory agencies as required by local, state and federal laws. Caltrans will not issue the rider permit until it has reviewed and approved the TSI's civil plans.

9.3.2 Take all steps necessary to obtain approvals and to implement the transition and installation of the ELN system, pursuant to the approved Transition and Installation Plan.

9.3.3 Prepare and document the mechanical assembly and installation details utilizing drawings, illustrations and other aids to describe the design environment and interconnection diagrams showing the general physical arrangement of devices and all external connections between devices.

9.3.4 Produce 100% complete approved installation plans and drawings sixty (60) Days prior to the start of installation.

9.3.5 Submit all third party maintenance/support agreements to BAIFA sixty (60) Days prior to the start of installation.

9.3.6 Prepare and submit all installation and shop drawings to BAIFA, in accordance with Caltrans submittal requirements.

9.3.7 Submit and receive BAIFA and Caltrans approval on all necessary plans, drawings, and documents before transition and installation activities begin. Following completion of all test phases, allot time to prepare for system cutover to production and roadway opening to traffic.

9.3.8 System activities during installation preparation include all tasks necessary to ready the production environments of all involved systems to begin processing transactions for the new Corridor(s) involved in the go-live. Plan and coordinate carefully as necessary to ensure that the systems already in use are not negatively impacted. For example:

9.3.8.1 Migration of new, tested system software versions from test environments into the production environment, without impacting the day-to-day live operation.

9.3.8.2 Manual entry and/or import of new lane configuration data, pricing rules, etc., into the production environment just prior to go-live.

9.4 Installation

TSI shall perform installation activities pursuant to the approved SDD and Installation and Cutover Plans. TSI shall receive BAIFA written approval of an installation before moving on to the next installation. If the TSI has received approval for parallel installation efforts, then the TSI shall obtain BAIFA written approval of an installation before moving onto the next installation on each parallel installation track.

9.4.1 Qualified Personnel

9.4.1.1 The TSI shall utilize the services of a fully qualified engineer for the purpose of performing all engineering civil, structural, electrical, mechanical, and architectural design and the preparation of related plans and documentation under this project. All engineering civil, structural, electrical, mechanical, and architectural design work shall be performed under the direct supervision of an engineer of the appropriate discipline licensed in the state of California or an architect licensed in the state of California.

9.4.1.2 All installation and testing of communications equipment and wiring shall be done in a neat and professional manner by qualified network technicians.

9.4.1.3 Electrical work shall be performed by California licensed electricians. All electrical work shall be performed in accordance with the applicable regulations. Appropriate National Electric Code compliance shall be adhered to with all electrical articles for installation pertaining to wiring, enclosures, and other electrical equipment in hazardous locations.

9.4.1.4 The TSI shall ensure that each sub-contractor performing construction or installation work under the TSI holds all necessary California contractors' or other licenses and provides proof of such licensing at BAIFA request.

9.4.2 Inspections

9.4.2.1 BAIFA, Caltrans and/or their designee shall have access and time to inspect all aspects of installation. TSI shall identify inspection points in the installation plan and the installation schedule shall allow time for inspections to be performed.

9.4.2.2 The TSI shall also be responsible for conducting routine inspections of all installations and certifying in writing that the TSI has completed installation per the approved documentation and drawings.

9.4.3 All equipment shall be installed, configured and tested in strict accordance with the original manufacturer's instructions. The manufacturer's printed or verbal recommended installation procedures and instructions for all materials furnished by the Contractor under this Agreement shall be followed explicitly, unless otherwise directed by BAIFA.

9.4.4 All wiring and cabling, including copper data and power cables, shall be neatly labeled, bundled, tie-wrapped, and secured. Wire labels shall be plastic permanent-type labels. Coordinate wiring and cabling labels with TSI shop drawings.

9.4.5 Utilize existing cable management where available. In existing racks that do not have cable management, provide cable management that is compatible with the existing rack.

9.4.6 The TSI shall label everything installed as a part of the TCS including but not limited to equipment, cables, and conduit. BAIFA shall have final approval of such labeling. The labeling shall enable efficient maintenance and inventory.

9.4.7 TSI Internal Test Results and Certification of Test Readiness

The TSI shall provide proof to BAIFA upon request that the installed equipment is ready for testing. Such proof would consist of, but not be limited to, the following:

- Reports from fiber-optic cable, Ethernet switch and/or wireless bridge testing to industry standard
- Reports on power connectivity, uninterruptable power supply, and equipment power-up
- Reports on functional testing of all individual subsystems such as AVI, VES, or VTMS
- Pre certification of roadside equipment

9.4.8 Deviations from Plans

The TSI shall notify BAIFA in writing as quickly as possible with regard to any potential deviation from the approved design and installation documentation, drawings, and plans. Such notification shall take place prior to further action except where delays may cause safety risks. Revisions to the plans for any roadside installations shall be developed by a fully qualified engineer and reviewed and approved by BAIFA and any other necessary agencies such as Caltrans.

9.4.9 Documentation

9.4.9.1 The TSI shall maintain records and documentation essential to providing objective evidence of quality, which shall be made available to BAIFA upon request. Examples of quality-related data include:

- Installation documentation
- Inspection and test results
- Records of quality assurance/quality control programs
- Cost records pertinent to acceptance of nonconforming material
- Change Order backup documentation
- Design reviews and walkthroughs
- Results of internal TSI audits
- Minutes of civil coordination meetings/discussions

9.4.9.2 Records shall be maintained in a manner that allows for easy access and analysis and consistent with the WBS.

9.4.9.3 The TSI shall develop and maintain an implementation issue and risk control register, as well as a procedure for identifying, classifying, assigning, tracking transition issues, and risks.

9.4.9.4 TSI shall maintain a punch list during implementation for review with the BAIFA project manager on a weekly basis.

9.4.9.5 The TSI shall submit as-built drawings per Attachment B, Schedule and Project Milestone Dates as applied to each Corridor installation.

9.4.10 Meetings

The TSI shall schedule and conduct regular installation progress meetings with BAIFA to proactively provide a status on the installation schedule, discuss installation issues and resolutions, and note any modifications to installation procedures or design documentation. The TSI shall ensure that the appropriate personnel are present at these meetings and can accurately provide information necessary in a meaningful manner. The TSI shall establish and distribute the meeting agenda prior to all meetings.

10. Testing

This section describes the TSI's responsibilities for carrying out and reporting the results of various functional and performance tests of the ELN system and its major components as they are being developed, demonstrated, deployed, and operated. This includes all phases of testing of the ELN software, Hardware, in-lane equipment, network connections, and interfaces. The testing program is intended to ensure that the ELN system functions according to the requirements and performance requirements prescribed in the Work under the Agreement, and the System Design Document.

10.1 General

10.1.1 The TSI shall be responsible for all personnel, equipment and expenses associated with the testing program.

10.1.2 Testing shall be conducted in accordance with the Master Test Plan and in conjunction with BAIFA.

10.1.3 The TSI shall submit each test plan to BAIFA in advance for review and revision. The TSI shall obtain BAIFA approval of test plans prior to testing.

10.1.4 BAIFA reserves the right to recommend ad hoc testing of any variety of vehicle types or equipment failures not included in the TSI's test plan. Ad hoc tests may be added before or during actual testing.

10.1.5 The TSI shall work with BAIFA to schedule tests so that BAIFA staff, consultants and partners may observe all testing.

10.1.6 The TSI shall include test data sufficient in size and variety of types to fully test all of the lane and Host systems' requirements including, but not limited to, financial integrity and audit functions.

10.1.7 Acceptance of the ELN system is dependent on meeting or surpassing each of the performance criteria specified in Attachment C, Performance Requirements and Penalties.

10.1.8 Within fourteen (14) Days of the completion of each individual test, the TSI shall provide for BAIFA approval a report containing results of each test script, a summary of the test results and a punch list of failed items. The TSI shall maintain all test results, notes, and observations.

10.1.8.1 BAIFA and the TSI shall work together to indicate a priority level for each punch list item. The TSI shall fix and retest high priority punch list items including necessary regression testing for BAIFA's approval. This process shall continue until all punch list items that BAIFA deems high priority have passed testing. At this time, BAIFA shall allow the TSI to proceed with other testing or installations.

10.1.8.2 The TSI and BAIFA shall agree on a schedule for fixing and retesting lower priority punch list items. If BAIFA and the TSI do not come to a separate agreement, the TSI shall fix and retest all lower priority punch list items within 30 days of passing testing on high priority test items. When BAIFA has received documentation and deems that all punch list items have passed testing, the TSI passes that test.

10.1.9 If testing or use identifies defects in the system after the system goes live (is in use by actual customers), the TSI shall go through code release procedures described and approved in the Quality Management Plan. The TSI shall never change the production system without prior approval of an authorized BAIFA representative.

10.2 Master Test Plan

10.2.1 A Master Test Plan provides a system-wide framework for testing activities by integrating functional, system, and performance testing of system components, subsystems, interfaces, and the overall system.

10.2.2 The TSI shall provide for BAIFA's review and approval a Master Test Plan describing in detail the key features of the overall testing program. At a minimum, the Master Test Plan shall address testing approaches and schedule, performance criteria, data collection and sampling methods, testing conditions, testing locations, reporting of results and procedures for tracking and retesting failed test steps.

10.2.3 The Master Test Plan shall describe strategies for isolating test data from production data, coordinating interface testing with RCSC and 511, using simulated data, and retesting.

10.2.4 The Master Test Plan shall include the Requirements Traceability Matrix and indicate when and how each requirement will be tested in the FAT and other individual test plans.

10.3 Individual Test Plans

10.3.1 General

10.3.1.1 Individual test plans shall describe the scope, approach, resources, and schedule of intended testing activities, including test items, the features to be tested, the testing procedures and set of execution conditions, predicted results, and any risks requiring contingency planning.

10.3.1.2 Individual test plans shall include an updated Requirements Traceability Matrix indicating which requirements are tested in that individual test.

10.3.1.3 The TSI shall have provided complete Individual Test Plans for BAIFA's review, and received BAIFA's written approval, prior to the beginning of any test.

10.3.1.4 The TSI shall update each version of the test plans to incorporate or respond to BAIFA's comments on the previous version. Each individual test plan shall undergo the following review phases:

- Test plan outline – allow 10 working days for BAIFA review and comments
- Detailed test plan – first submission – allow 15 working days for BAIFA review and comments
- Detailed test plan – second submission – allow 15 working days for BAIFA review and comments
- Detailed test plan – final version – TSI shall submit a final detailed test plan in accordance with Attachment B, Schedule and Project Milestone Dates, or if not specified therein, 15 working days prior to the start of that test

10.3.2 First Corridor Deployment

For the installation Corridor deployed, the TSI shall develop individual test plans for each of the major tests including the:

- Factory Acceptance Test
- Onsite first installation test (OFIT)

- First Zone test
- Communications end-to-end test
- Corridor test
- Disaster recovery test
- End-to-end test
- Operations test
- Site commissioning test

10.3.3 Subsequent Corridor Deployments

For each subsequent Corridor, the TSI shall provide updated versions of the following individual test plans:

- Corridor test
- Site commissioning test
- Operations test

10.3.4 System Acceptance

10.3.4.1 When all Corridors designated in the Agreement have been deployed, the TSI shall conduct a System Acceptance test on the fully installed ELN.

10.3.4.2 The System Acceptance Test shall include but not be limited to:

- Addressing BAIFA testing priorities.
- Ensuring the accuracy, consistency and completeness of data recorded in the database and reflected in reports.
- Performance monitoring and ensuring that such performance is maintained under high transaction volumes.
- Using and configuring the pricing algorithm and trip building functionality.
- Conducting a detailed test of the "consolidated financial reports" which shall include tests to determine that all transactions are accurately summarized, fully accounted for, and supported by detailed transaction reports.

10.3.4.3 The TSI shall continue to use the methods established under Operations Testing for BAIFA to report issues and defects discovered during the course of day-to-day operations of the ELN system.

10.3.4.4 The TSI shall create a punch list of defects and a report on performance requirements early in the System Acceptance testing period to allow early fixes and retesting without requiring significant delays in the project. BAIFA approval depends on at least 60 consecutive days of ELN operations at the specified performance requirements and without the detection of high priority defects.

10.3.4.5 The TSI shall obtain approval of the System Acceptance Test in accordance with Attachment B, Schedule and Project Milestone Dates.

10.4 Test Descriptions

Test phases observable by and reported on to BAIFA or its designee shall include:

10.4.1 Factory Acceptance Testing (FAT)

10.4.1.1 The FAT shall occur at the end of development and prior to the installation of any TSI equipment in BAIFA facilities.

10.4.1.2 The FAT shall take place at the TSI's facility in a manner that is easily observable by BAIFA personnel.

10.4.1.3 The FAT shall take place in the continental United States.

10.4.1.4 The FAT shall be a complete test of the integrated TCS using exactly the same equipment and configurations as the TSI will use in production following the BAIFA approved test plan and test scripts. The FAT shall include the communications Hardware.

10.4.1.5 The FAT shall include testing of the AVI subsystem to operate in dual protocol mode.

10.4.1.6 The test plan shall list requirements that the TSI will not test in the FAT and the reason for their exclusion.

10.4.1.7 The TSI shall create files for sending to the RCSC, and coordinate with the RCSC to send these files and receive associated response files for these test transactions.

10.4.1.8 The TSI shall include a test of the Digital Video Auditing System (DVAS).

10.4.1.9 The TSI shall conduct a preliminary test of all other interfaces.

10.4.1.10 TSI shall use traffic simulation software or other mutually agreed upon traffic data sets to create necessary traffic data and use it to perform tests including, but not limited to, the following:

- volume stress tests
- fully exercise reports
- pricing algorithm tests

10.4.1.11 Onsite first installation tests cannot begin until FAT results are approved by BAIFA.

10.4.2 Communications End-to-End Test (before OFIT and each of the Corridor Tests)

10.4.2.1 The Communications End-to-End Test shall be a complete series of tests of the communications media and connectivity. The test plan shall tie in with

the Requirements Traceability Matrix indicating which requirements are included in the test.

10.4.2.2 The communications media (single-mode fiber-optic cable) shall be tested on reel prior to installation and after installation.

10.4.2.3 The test of the network and communications Hardware shall demonstrate:

- Connectivity
- Reconvergence upon loss of communications
- System security
- Monitoring, polling and trap incidents and alerts to MOMS subsystem

10.4.3 Onsite First Installation Test (OFIT)

10.4.3.1 The OFIT shall be as complete a test of the integrated TCS as allowed by the installation of a single set of roadside equipment. The test plan shall tie in with the Requirements Traceability Matrix indicating which requirements are included in the test.

10.4.3.2 The OFIT shall take place after the installation of the Host site, the TMC, plus a full set of equipment at the roadside including, but not limited to, all the equipment necessary to:

- create Lane Transactions (tagged and image-based)
- trigger and light enforcement beacons
- display prices on variable toll message signs
- collect traffic data from traffic monitoring system sensors
- view digital video audit system output
- view CCTV output
- communicate with the Host

10.4.3.3 The OFIT shall include tests of the network configurations at both the lane and Host levels.

10.4.3.4 The TSI shall demonstrate that the AVI subsystem meets performance standards for reading Title 21 compliant transponders and for 6C.

10.4.3.5 The TSI shall execute the OFIT at the first site handed over by the Civil Contractor(s).

10.4.3.6 BAIFA or its contractors agree to have the necessary civil work, power and communication infrastructure available to make this test feasible. BAIFA or its contractors will have conducted such inspections and/or testing necessary to ensure this infrastructure is suitable for a test site.

10.4.3.7 The TSI shall have conducted and signed off on the Civil Site Checklist prior to the beginning of OFIT.

10.4.3.8 The TSI shall not start further installations until BAIFA approves OFIT results.

10.4.4 Site Commission Testing

10.4.4.1 A Site Commissioning Test shall be successfully completed for every installation site.

10.4.4.2 After OFIT, the TSI shall perform this test for each subsequent set of roadside equipment, to ensure that lane and communications equipment is installed correctly and recognized by the system. In the Site Commission Test Plan, the TSI shall propose the scope of such site commission tests.

10.4.4.3 This test shall be an abbreviated version of the OFIT concentrating on testing the functionality of roadside equipment (including AVI) and its connection to the Host.

10.4.4.4 This test shall also contain an abbreviated version of the Communications End-to-End Test as approved by BAIFA.

10.4.4.5 BAIFA or its contractors agree to have the necessary civil work, power and communication infrastructure available to make the Site Commissioning Test feasible. BAIFA or its contractors will have conducted such inspections and/or testing necessary to ensure this infrastructure is suitable for a test site.

10.4.4.6 The TSI shall have conducted and signed off on the Civil Site Checklist prior to the Site Commissioning Test.

10.4.4.7 Where two Read Points share a Lane Controller, commission testing should test both sites in parallel to ensure that the shared Lane Controller supports full operation.

10.4.4.8 The TSI shall successfully complete all site commission tests for the equipment in the first Zone and obtain BAIFA written approval prior to Zone testing.

10.4.5 First Zone Test

10.4.5.1 The TSI shall conduct the first Zone test when all roadside equipment within the first Zone has been successfully commissioned.

10.4.5.2 As soon as possible, the Host shall begin gathering real traffic data. The TSI shall use this data in the First Zone test to test the Dynamic Pricing algorithm.

10.4.5.3 This test shall focus on ensuring that the Host can meet all requirements when faced with multiple equipment sites that roll up into a single Zone. The test shall include using vehicles to create actual Lane Transactions in many different configurations. The test shall include, but not be limited to, the following:

- Correct Trip Building and toll rate assignment
- Exception processing
- Toll rate corrections
- Incident reporting
- Accounting and audit functionality
- Failure conditions

10.4.5.4 Approval of First Zone Test results shall be a prerequisite for Corridor Testing in the first Corridor.

10.4.6 Corridor Testing (done for each Corridor)

10.4.6.1 The TSI shall conduct a Corridor test for each Corridor when installation is complete. The TSI may propose to combine this test with the End-to-End Test and/or the Disaster Recovery Test for the first Corridor installation.

10.4.6.2 This test shall focus on functionality that could not be tested in previous on site tests or functionality that changes when a full Corridor exists. This test will include actual vehicles driving to create Lane Transactions in many combinations. It will also include Lane Transactions created in various failure modes. The Corridor test plan shall include but not be limited to:

- Live traffic data capture and transaction assembly
- Multi-Zone pricing and Trip Building
- Toll Rate overrides
- Reports across multiple Zones
- Building of files to send to the RCSC
- Ad-hoc report building capacity

10.4.7 Disaster Recovery and Back–Up Test

10.4.7.1 The TSI shall conduct a complete test of the disaster recovery and back-up equipment and plans. The plan for this test shall include instructions for mimicking several disaster and failure scenarios, which the TSI will outline in its Disaster Recovery Plan.

10.4.7.2 The testers shall follow the procedures outlined in the Disaster Recovery Plan to determine whether both the system and the Disaster Recovery Plan allow BAIFA to continue operations and recover all data.

10.4.7.3 Cutover preparation cannot begin until the test results for disaster recovery and back-up testing have been approved by BAIFA.

10.4.8 End-to-End Testing

10.4.8.1 The TSI shall complete full testing of all system functionality, from the lane through the Host to the RCSC test system, for use in validating transaction processing through the RCSC.

10.4.8.2 The TSI shall send transaction files, correction files and all other required communications to the RCSC. The TSI shall receive reconciliation files and all other required communications from the RCSC. The test shall demonstrate that these files are complete and accurate. The test shall demonstrate that the reconciliation data is properly stored in the database and reflected on all reports.

10.4.8.3 The TSI shall test all other Interfaces.

10.4.8.4 The test shall demonstrate that CHP and customer service representative (CSR) users can properly access the required screens and data and not access unauthorized portions of the system through the web portal.

10.4.8.5 Cutover preparation cannot begin until the test results for End-to-End testing have been approved by BAIFA.

10.4.9 Operations Testing (done for each Corridor)

10.4.9.1 After cutover of each Corridor, the TSI shall conduct operations testing. This test shall not be a scripted, controlled test but rather systematic monitoring of the system after it is open to the public.

10.4.9.2 The Operations Test plan shall detail the methods, amounts, and types of data collected during the testing period. The test plan shall detail the method for evaluating how these data collection efforts demonstrate that the system meets functional and performance requirements.

10.4.9.3 The TSI shall provide a method for BAIFA to formally report issues and defects discovered during the course of day to day operations of the ELN system.

10.4.9.4 The TSI shall create a punch list of defects and a report on performance requirements early in the operations testing period to allow early fixes and retesting without requiring significant delays in the project. BAIFA approval depends on at least 30 consecutive days of ELN operations at the specified performance requirements and without the detection of high priority defects.

10.5 Test Environment

10.5.1 The TSI shall maintain a test environment that will ensure that BAIFA's Host and lane software, firmware and Hardware configurations are matched exactly during every phase of development, installation, and testing.

10.5.2 When the TSI is conducting a BAIFA observed test, TSI staff shall not make changes to the test environment without specific written approval from an authorized BAIFA representative. This includes, but is not limited to, configuration changes, database changes, software code changes, and equipment changes. Should BAIFA approve such a change, the TSI shall document those changes in the test report.

11. Training Requirements

One of BAIFA's goals is to have a well-trained workforce responsible for the ELN system. Both initial and continuous ELN workforce training is paramount to the project's success.

11.1 Training Plan

11.1.1 The TSI shall meet with BAIFA to discover the various groups of BAIFA personnel and other system users who will need training and explore their training needs. The TSI shall use the results of this meeting in developing the Training Plan.

11.1.2 The TSI shall prepare and submit for BAIFA review a Training Plan with a supporting training schedule.

11.1.3 The Training Plan shall include a training system flowchart that depicts trainee groups with corresponding required and elective training courses.

11.1.4 For each specific training course, the TSI shall include at a minimum: course title, content outline, method of delivery, equipment to be used, media to be employed, list of materials required, course length, optimum number of students, course objectives, course success criteria, and any required prerequisite courses for each proposed course.

11.2 Training Materials and User Manuals

11.2.1 At a minimum, the TSI shall develop and provide the BAIFA approved training materials listed below in accordance with Attachment B, Schedule and Project Milestone Dates.

- Classroom training materials for students
- Classroom slide presentation or instructor materials
- All user and maintenance manuals
- Evaluation forms

11.2.2 With proper notification, BAIFA shall make an effort to provide a space for training that includes BAIFA personnel or other persons BAIFA designates for training. The TSI shall

be responsible for providing all training material, computers, projectors, projector screens, video players, meals, and supplies required for the training class. All training shall be included in the Project Schedule.

11.2.3 The TSI shall deliver training materials to BAIFA in both hard copy and electronic format.

11.2.4 The TSI shall provide hard copies of the training materials for each person being trained.

11.2.5 The TSI shall revise the training program, Training Plan and training documentation and classroom materials, as necessary, throughout the contract term based on feedback from BAIFA.

11.3 Training Implementation

The TSI shall:

11.3.1 Train various BAIFA employees and other system users in the operation, maintenance and support of the entire ELN system. This shall include database administration and system administration training that provides a comprehensive overview of the system software design.

11.3.2 Use a blended learning approach consisting of a combination of classroom, computer-based, hands-on, on-the-job, train-the-trainer, and interactive self-instructional modules.

11.3.3 For each course, provide a training exercise to demonstrate through hands-on activities the subject matter covered in the course lecture or course section.

11.3.4 Provide training directly to end users, including BAIFA staff, Regional Customer Service Center CSR's, CHP officers, and others identified in the training plan. Training shall include initial and refresher courses twice a year.

11.3.5 Conduct training classes for the financial and audit staff on the usage of the system to generate reports, audit of collection, and preparation of ad hoc queries.

11.3.6 Provide training for BAIFA software support, administration, information technology and maintenance staff; and BATA bridge maintenance and warranty contract management staff.

11.3.7 Ensure that all classroom training is provided by professional, qualified trainers supported by appropriate technical experts.

11.3.8 Develop and manage post-training evaluation and feedback from students immediately after each course completion and after 30 days of practical use of the toll

collection system. These evaluations shall be used to refine future training sessions and courses.

11.3.9 The TSI shall complete training according to Attachment B, Schedule and Project Milestone Dates.

12. Software and Documentation Requirements

12.1 General Requirements

12.1.1 The TSI shall be responsible for documentation of all project activities. This section is general in nature and applies to all project documentation. For specific documentation requirements, see the pertinent subsections of this document.

12.1.2 Document Updates - The TSI shall update project documents in accordance to the PMP during the life of the project. If substantial changes occur in aspect of the project, the TSI shall update relevant documentation within one month of that change, unless a specific alternative update schedule is required.

12.1.3 Document Retention - The TSI shall maintain a library of current versions of all project documents. The TSI shall maintain this library in a secure location with web access by all approved members of the project team.

12.1.4 The TSI shall submit all documentation and plans in the English language.

12.1.5 All Work documentation shall be maintained in formats found in the Microsoft Office suite. Hardcopies shall be made available to BAIFA upon request.

12.1.6 All project-related electronic files shall be partially backed up daily and fully backed up weekly.

12.1.7 External references to files and figures should not be permitted. Manuals shall be delivered as bound documents or in binders to facilitate review and use of the documents.

12.1.8 Each manual produced for the ELN system shall contain a title sheet, table of contents, list of illustrations (if applicable), revision log, and list of reference drawings (if applicable).

12.1.9 With the exception of the original equipment manufacturer standard documentation (e.g., manuals, catalogs), all manuals, section numbers, line numbers, page numbers, version numbers, records, and lists shall be printed double-side on 8-1/2" by 11" sheets and may include 11" by 17" “engineering fold” inserts.

12.1.10 The left-hand margin of the sheets in the manuals shall be adequate to ensure binding without encumbering the reading of the material.

12.1.11 All drawings, graphs, plans, charts, illustrations, etc. shall be produced with the aid of computer aided drafting software or other software approved by BAIFA (e.g. Microsoft Visio).

12.1.12 The TSI shall deliver all materials, software and related documentation in compliance with the Agreement regarding Source Code. The TSI shall deliver these materials to BAIFA with enough time to meet the Attachment B, Schedule and Project Milestone Dates.

12.1.13 A BAIFA designated and funded Third Party will follow the Source Code Documentation and load the Source Code on a server and compile it. The Third Party will provide written feedback if the compilation effort fails.

12.1.14 If the Third Party succeeds in compiling the Source Code, the TSI meets the Third Party Source Code Compilation Milestone.

12.1.15 The TSI may request to observe the Source Code compilation.

12.2 Maintenance Manuals

12.2.1 The TSI shall develop and maintain a Software Maintenance Manual, a Hardware Maintenance Manual, Communications Maintenance Manual and a Maintenance Online Management System Operators Manual as reference guides for maintenance managers and staff technicians. The TSI shall provide the maintenance manuals in soft copy as well as in three-ring binder format to facilitate updating and integration with the SMP.

12.2.2 The maintenance manuals shall describe the following BAIFA ELN system maintenance program components:

12.2.2.1 Preservation policies and performance requirements;

12.2.2.2 Maintenance, repair and preservation approaches and process schematics;

12.2.2.3 Installation and setup plans;

12.2.2.4 Diagnostic Hardware and software tools and techniques;

12.2.2.5 Resource requirements, roles and responsibilities;

12.2.2.6 Schedule of activities, including preventive maintenance activities such as scheduled inspection, renewal or replacement and testing of on-site and off-site system components;

12.2.2.7 Quality control/assurance procedures and reports on the condition of BAIFA ELN software, Hardware, communications and peripheral equipment;

12.2.2.8 Operation of MOMS including the handling of alarms, work orders, reports, inventory, scheduled preventative maintenance, scheduled monitoring and monitoring results.

12.2.3 The Maintenance Manuals shall undergo the same delivery process as required for all project documents and deliver a final draft with BAIFA written approval according to Attachment B, Schedule and Project Milestone Dates.

12.2.4 The TSI shall update the Maintenance Manuals throughout the maintenance and warranty period at least once per year and whenever the TSI make significant changes in equipment or maintenance procedures.

12.3 User Manuals

12.3.1 The TSI shall produce and maintain, for the life of this contract, a set of system user manuals. Standard user manuals for commercial products will be acceptable if they contain sufficient information to service the component equipment.

12.3.2 Prior to developing User Manuals, the TSI shall prepare for BAIFA's review and approval, a draft table of contents and concept outline depicting the proposed content for all User Manuals.

12.3.3 The User Manuals shall provide complete and detailed descriptions of how and when users should operate the ELN system. The User Manuals shall include a general description, the theory of operation, instructions for navigating through the system and detailed step by step instructions for each system function.

12.3.4 The TSI shall provide manuals, including but not limited to, the following:

- Database and Software Administrator Manual
- System Configuration and Administration Manual
- Network Administrator Manual
- External Interfaces
- Finance Manual
- Research Screens
- CHP Web portal
- Ad-Hoc Reports Manual including a Data Dictionary
- Reports Manual
- Traffic Operations Manual

12.4 Technical Documentation

Drawings provide specific product and installation details. The TSI shall prepare accurate and complete drawings for the entire ELN system.

12.4.1 As-Built Drawings

12.4.1.1 The TSI shall create as-built drawings for the entire ELN system.

12.4.1.2 The TSI shall keep accurate records of as-built drawings and diagrams and any deviations from original drawings and diagrams.

12.4.1.3 The set of diagrams shall include all schematics, block diagrams, logic diagrams, layouts, wiring diagrams, assembly drawings, software build and implementation records, and parts detail drawings for all mechanical parts designed or modified.

12.4.1.4 Documentation of the communication network shall include the sequential cable length markings at each splice box and pull box wall that the cable passes through and Ethernet cable manufacturer's recommended and maximum pulling tensions for each Ethernet cable size.

12.4.2 Bill of Materials

12.4.2.1 The TSI shall prepare and submit a bill of materials list that includes parts and components making up each device implemented under this Agreement and shall provide illustrations of the parts and components.

12.4.2.2 A parts list for each system device shall include all parts and components making up that device and shall provide pictures, exploded view diagrams, part numbers and names.

12.4.2.3 The final bill of materials list shall be delivered no later than thirty (30) days after the last Corridor is accepted and final acceptance testing has begun.

12.5 Final Design Document

The TSI shall update the System Design Document to reflect the design of the system at the time of system acceptance. The TSI shall match the Final Design Document to an updated Requirements Traceability Matrix that reflects all approved change orders. This document shall be submitted to BAIFA for review. The TSI shall revise the document to reflect BAIFA's comments and submit a final version for approval.

RFP APPENDIX 1: Attachment A-3

BAIFA
BAY AREA INFRASTRUCTURE FINANCING AUTHORITY

BAIFA Express Lane Network

Toll Collection System

Maintenance and Warranty Requirements

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Maintenance and Warranty Requirements

1. General Requirements

1.1 The Toll System Integrator (TSI) shall provide all maintenance services to ensure that the Toll Collection System (TCS) operates twenty-four (24) hours a day, seven (7) days a week in a proper, safe and efficient operating condition capable of accurate toll revenue collection and reporting, and meets all specified performance and functional requirements.

1.2 The TSI shall provide these services during the Warranty period and the maintenance period as defined in the Agreement.

1.3 The TSI shall maintain all lease and Warranty agreements including but not limited to leased lines, software agreements and Hardware licensing during the Warranty and maintenance period as defined in the Agreement.

1.4 The TSI shall provide all necessary staffing, material and supplies to perform preventive, predictive and remedial maintenance, install software updates to maintain the TCS, including but not limited to: Lane Controllers, Automatic Vehicle Identification (AVI) subsystems, Automatic Vehicle Classification (AVC) subsystem, Violation Enforcement System (VES) subsystem, Closed-Circuit Television (CCTV), Variable Toll Message Sign (VTMS), all electronics in the roadside equipment cabinets, roadside network equipment and cables, roadside equipment cabinets and associated electronics, equipment mounting and brackets, lane equipment needed for ongoing development and test support, Host servers and central processing systems inclusive of operating systems, databases, backup systems, storage devices, Toll Rate Test Environment, Digital Video Auditing System (DVAS), roadside communications and interfaces with the Host and the Regional Customer Service Center (RCSC), etc.

1.5 The TSI shall monitor and report all maintenance and Warranty activities to Bay Area Infrastructure Financing Authority (BAIFA), manage spare parts inventory, and coordinate work with BAIFA, California Department of Transportation (Caltrans) and other contractors.

1.6 The TSI shall maintain equipment for the video wall, servers, associated video equipment, and network connectivity. Workstations and peripherals provided by the TSI shall be maintained by BAIFA.

1.7 The TSI shall perform the maintenance services according to the System Maintenance Plan (SMP) submitted to and approved by BAIFA.

1.8 All service, maintenance, errors, resolutions, remediation, parts, inventories and the like shall be documented in the Maintenance Online Management System (MOMS) and shall be available to BAIFA.

1.9 During maintenance, system improvements shall be performed in accordance with the Agreement.

1.10 TSI shall be required to track changes to requirements made through system improvements using the Requirements Traceability Matrix (RTM). Changes to requirements are subject to BAIFA's approval.

1.11 TSI shall be required to associate each change with the software version in which it was put into production.

1.12 TSI shall be required to perform full testing and update system documentation for all system improvements and changes.

1.13 TSI shall maintain processes and procedures required under *Attachment A-2*, Implementation Requirements. The TSI's Project Management Plan shall be updated to reflect any changes or refinements to processes and procedures during the Maintenance and Warranty periods, and no less than annually.

2. Toll System Maintenance Plan

2.1 The TSI shall develop and institute a SMP for BAIFA ELN. The initial version of the SMP shall be submitted to BAIFA for approval in a three-ring binder format to facilitate updating.

2.2 The SMP shall define the policies, roles, responsibilities, schedule of activities and resources for maintaining BAIFA ELN software and Hardware at the Read Point, Corridor, roadside communications and Host levels.

2.3 The SMP shall include plans for maintaining the system including but not limited to the following:

2.3.1 Maintaining a current descriptive inventory of all Hardware, system software, source code and changes to the software on a system-wide or Corridor basis; conducting an annual condition assessment and report of system components with an emphasis on issue and concerns, including components critical to toll collection whose failures would lead to major disruptions in system functionality and performance; performing scheduled and random quality control and assurance testing of system components as well as overall system performance;

2.3.2 Developing and updating preventive maintenance schedules to ensure preventive maintenance occurs outside of the peak travel periods;

2.3.3 Dealing with contingencies such as emergency maintenance, security breaches, stolen equipment (ie copper theft), sick employees or vehicular crashes at or near tolling equipment or facilities; and

2.3.4 Updating all relevant documentation with BAIFA updates, review, and approval when making changes to the system.

2.3.5 Providing monthly maintenance request reports that summarizes all maintenance requests and disposition to BAIFA.

3. Toll Collection System Warranty Period

3.1 Maintenance during Hardware, software, and TCS warranty periods (referred to as "Warranty" herein) shall only cover the cost of labor not included in the manufacturer's Warranty of Hardware and systems.

3.2 The Toll Collection System (TCS) equipment and Hardware Warranty shall be in effect for one (1) year commencing on the Guaranteed Completion Date for the Operations Test milestone shown in *Attachment B*, Schedule and Project Milestone Dates for each Corridor. Warranty periods may not necessarily be concurrent for equipment and Hardware commissioned at different times.

3.3 The one (1) year Warranty on the TCS covers Hardware and software and is therefore to be replaced or repaired in the case of Warranty failure or malfunction at no material cost to BAFIA.

3.4 During the Warranty period, the TSI shall perform all maintenance services described in this Scope of Work and according to the BAIFA approved SMP and have full responsibility of the TCS including preventive and corrective maintenance and code changes, system administration, the repair or replacement of parts and expendables as well as any other time and material necessary to meet the specified performance requirements at no additional cost to BAIFA.

4. Toll Collection System Maintenance Period

4.1 The TSI shall perform all maintenance services described in this Scope of Work and according to the BAIFA approved SMP. The TSI will be compensated for maintenance services according to the monthly unit price. The TSI will be reimbursed, at cost, for all replacement spare parts, including delivery costs, which have been received and successfully tested by the TSI. No markup on the components is permitted under this Agreement.

4.2 The TSI must identify the lead time required for orders of additional and replacement components and spare parts. Proposers also need to identify time frames for repair and replacement of component parts, and specify Warranty period. The lead times and Warranty periods identified must be guaranteed throughout the life of the Agreement.

4.3 The TSI shall assume full responsibility for a toll equipment location as soon as the first piece of equipment at the toll equipment location has been installed.

5. Maintenance Equipment

The TSI shall provide all materials, supplies and equipment required to maintain the BAIFA ELN system including, but not limited to:

5.1 Maintenance facility

5.2 Maintenance vehicles, lifts, vehicle maintenance, gasoline and other associated vehicle costs

5.3 Cones, warning signs, gates, lighting, generators, tools and expendables such as tape, solder, etc.

5.4 Diagnostic, calibration and bench test setup equipment and the TCS components used for the bench test system and the maintenance computer system

5.5 The TSI shall maintain a BAIFA-owned dedicated Read Point/Corridor/Host test computer system at the TSI's development facility for the life of the maintenance project

5.6 The TSI shall maintain an up-to-date list of all maintenance equipment and shall provide it to BAIFA as part of the monthly documents

5.7 All equipment shall be surrendered to BAIFA at the end of the maintenance periods unless the Maintenance Agreement is renewed

6. Third Party Service Agreements

6.1 Should the TSI establish third party on-site service agreements from the original manufacturers or suppliers of equipment for Corridor and Host computers and other critical functions, the TSI shall be responsible for all services rendered by the third party. Third party agreements do not relieve the TSI of responsibility for Warranty and maintenance in accordance with the terms of the Agreement.

7. Coordination of Work

7.1 The TSI shall be responsible for the initial response, issue documentation and identification and isolation of all issues.

7.2 The TSI shall coordinate work with other parties such as BAIFA, Caltrans, and the Regional Customer Service Center, to fully resolve any issues with the TCS.

8. Local Office and Maintenance Facility

8.1 The TSI shall establish a local office and secure maintenance facility sufficient to store and repair the entire inventory of parts, components and equipment required to maintain the TSI. The maintenance facility shall be centrally located to allow the TSI to meet the response and repair times as defined in the Performance Requirements.

8.2 The maintenance facility shall have bench test facilities and simulators.

8.3 The maintenance facility shall provide working space for maintenance management and personnel.

8.4 The TSI shall ensure that BAIFA assets are not removed from Caltrans facilities unless directed by the BAIFA Project Manager.

9. Staffing and Organization

9.1 The TSI shall establish and maintain organizational resources appropriate to the Work to be performed to maintain the BAIFA ELN system, including, but not limited to:

9.1.1 Assigning the appropriate number of knowledgeable trained staff, acceptable to BAIFA, with skills appropriate to the tasks to be performed;

9.1.2 Supplying direct local supervision for proper management of staff;

9.1.3 Ensuring that at least two persons will have the ability to maintain any site or function;

9.1.4 Providing qualified persons, acceptable to BAIFA, for relief of the assigned staff in the event of vacation, illness, personal business or any other absence;

9.1.5 Providing staff with procedures for resolving technical issues which cannot be solved on-site and providing staff support where required; and

9.1.6 Providing maintenance staff with cell phones, laptop computers and wireless Internet access to respond to requests for services in a timely manner.

9.2 The TSI shall provide an organization chart indicating the number, location and position of full-time staff assigned to BAIFA ELN maintenance. The chart shall also indicate any part-time, support or other staff assigned to the maintenance work. The TSI shall update this chart whenever the maintenance staff changes and submit it with the monthly reports. Note that changes in the key personnel for maintenance are defined in the Agreement and require BAIFA approval.

9.3 The TSI shall develop and provide a regular ongoing training program appropriate to the needs of the BAIFA ELN system and the staff assigned to maintain the appropriate level of staff knowledge, skills and abilities. Training shall be open to BAIFA and any other parties deemed necessary by BAIFA.

9.4 The TSI shall maintain secure facilities and provide personnel who satisfy BAIFA and/or regulatory security requirements.

9.5 The TSI shall keep all information regarding its maintenance activities confidential and communicate such information only to authorized BAIFA personnel or BAIFA designated representatives.

9.6 The TSI and others under the management of the TSI shall adhere to Caltrans rules and regulations regarding physical access to all Caltrans properties.

9.7 The TSI shall adhere to BAIFA rules and regulations regarding physical access to all BAIFA properties.

10. Maintenance of Traffic

10.1 The TSI shall provide all maintenance of traffic as stipulated in Attachment A-2, Implementation Requirements.

10.2 The TSI shall follow BAIFA, California Highway Patrol (CHP), and Caltrans procedures for lane access, lane closure notification requirements, lane closure procedures, traffic protection rules and procedures and all other appropriate safety requirements.

10.3 Maintenance of traffic for closures of open-road lanes or multiple traffic lanes shall be performed by licensed personnel or subcontractors.

11. Maintenance Services

11.1 Preventive Maintenance

11.1.1 The TSI shall develop a comprehensive preventive maintenance plan as part of the SMP that includes daily, weekly, monthly, quarterly and annual preventive maintenance activities and a plan for actively monitoring and reporting on system performance.

11.1.2 Scheduled preventive maintenance shall consist of, but not be limited to, inspecting, testing, calibrating, cleaning, lubricating, adjusting, repairing, and replacing field-installable parts that are approaching unserviceable status, to prevent BAIFA ELN system failures and extend the useful life of the TCS. Such maintenance shall be performed in accordance with the SMP and at a minimum in accordance with the equipment manufacturers' recommendations or as directed by BAIFA.

11.1.3 Preventive maintenance schedules are subject to the approval of the Project Manager and/or BAIFA ELN Facility Manager. The TSI shall not remove any piece of equipment from service for preventive maintenance during peak operational periods without prior approval of the BAIFA Project Manager or designated facility manager.

11.1.4 The TSI shall provide at a minimum bi-annual preventive maintenance for each of the gantry mounted Variable Toll Message Signs (VTMS), Closed-Circuit Television (CCTV) cameras and all other associated equipment requiring the maintenance. Preventive maintenance consists at a minimum of cleaning front face of the sign, replacing any filters, cleaning the screen in front of the inlet fan and a visual check for worn, damaged or disconnected harnesses.

11.2 Remedial Maintenance

11.2.1 The TSI shall perform all on-call remedial or corrective maintenance that consists of actions necessary to diagnose and correct malfunctions and failures in the TCS. Remedial maintenance does not include services that are entirely due to force majeure, beyond the TSI's control (e.g., damage due to traffic accidents).

11.2.2 The TSI shall repair, replace, document and maintain any part or parts of the TCS that become unsuitable and are deemed to not be in accordance with their original specified performance requirements. Such repair or replacement shall be performed so that any

Read Point shall not be out of service for more than the allowable down time for repair. See Attachment C, Performance Requirements & Penalties.

11.2.3 The TSI shall provide methods and procedures for BAIFA and Caltrans to report problems by phone and email, which will generate TSI work orders.

11.2.4 The TSI shall establish a help-line number telephone service that is available 24 hours a day, 7 days a week for reporting problems and placing service requests to technicians. The TSI shall establish a protocol and provide a contact list for escalation of issues by BAIFA in the event of an unforeseen emergency and/or failure to respond by TSI.

11.3 Unanticipated Maintenance

11.3.1 Unanticipated maintenance services that are entirely due to occurrences beyond the TSI's control (e.g., damage due to traffic accidents,) shall not be included in the fixed price for maintenance and shall be compensated on a time and materials basis.

11.3.2 The TSI shall immediately notify BAIFA of the need for such work and request prior written approval to respond to such an occurrence.

11.4 System Monitoring

11.4.1 The TSI shall perform scheduled reviews of the TCS and regular TCS upkeep. On a scheduled basis, the TSI shall check the Hardware and software components of the system to ensure that all components are present and operating within specified parameters. Based on these reviews, the TSI shall perform needed system upkeep (e.g., de-fragmenting disk files, purging obsolete files from directories, etc.) to ensure uninterrupted operation of the system.

11.4.2 The TSI shall monitor the TCS. During operation, the TSI shall check system monitoring devices and programs, run-time system utilization parameters and other diagnostic tools (e.g., file size and allocations, processor loading, response times, etc.) to ensure that all aspects of the system are operating properly and the system is meeting all specified performance criteria. The monitoring schedule shall be included in the SMP.

11.4.3 The TSI shall monitor the integrity of databases. On a scheduled and real-time basis as appropriate, the TSI shall review system databases (tables, indexes, views/queries, etc.) to ensure that all are properly updated and that appropriate integrity of all system databases is maintained. Alerts shall be generated for anomalies immediately upon recognition.

11.4.4 The TSI shall maintain logs of all scheduled monitoring and system upkeep activities.

11.4.5 The TSI shall maintain logs or other appropriate records of all monitoring activities, anomalies found and measures taken to correct these anomalies.

11.4.6 TSI shall respond to routine operational requests (e.g. network mask, IP addresses, reconfigure VLAN).

11.4.7 The TCS shall perform periodic deletion of data as stipulated in System Requirements design documents and BAIFA data retention rules and policies.

11.5 Backup and Archiving

11.5.1 The TSI shall perform scheduled data, application and system backups as specified in the Toll System Maintenance Plan and ensure that backup media are properly stored and secured, rotated on schedule and replaced appropriately.

11.5.2 The TSI shall perform scheduled backups for off-site storage or rotate backup media to and from the off-site storage location as appropriate. The TSI shall ensure that viable and complete backups are delivered to the off-site storage location when scheduled and that media to be rotated are returned from off-site storage locations and returned to usage on the system as appropriate.

11.5.3 The TSI shall maintain records of backups including logs of all backup activity, rotation of backups and usage/rotation of backup media and records of all off-site data storage.

11.5.4 The TSI shall follow system archiving procedures to capture data to be archived to permanent storage media as required to maintain proper system functioning or as scheduled in the system operating procedures (whichever occurs first). The TSI shall ensure that archived media are properly logged and maintained and that archived data is viable and accessible throughout the required archive retention period for the data.

11.5.5 The TSI shall ensure that an adequate inventory of storage media for primary and backup purposes is available and procure additional storage media for backups and archiving data when needed.

11.5.6 The TSI shall perform periodic tests on the full Host and lane recovery to ensure entire TCS is recoverable from backups. Results of tests shall be documented and provided to BAIFA.

11.5.7 The TSI shall perform regular deletion of TCS data as stipulated in System Requirements, design documents, and BAIFA data retention policy.

12. Spare Parts Inventory

12.1 The TSI shall be responsible for the purchase, delivery, testing and maintenance of all spare parts which shall be as approved in the System Design Document. If alternative components are proposed after approval of the System Design Document, the component is subject to approval by BAIFA prior to use of a proposed product.

12.2 The TSI shall maintain a comprehensive system for managing spare parts and equipment in a secure manner that includes:

12.2.1 Record keeping of inventories including storage locations;

12.2.2 Determination of reorder points;

12.2.3 Maintaining supplier information;

12.2.4 The number of times a single component has been repaired shall be tracked and an alert shall be triggered if a component has been repaired three times or more.

12.2.5 Conducting parts acquisition and distribution; and

12.2.6 Testing the initial functionality of all spare parts and equipment, and returning all defective spare parts and equipment to their respective manufacturers for replacement.

12.3 The TSI shall keep a sufficient inventory of spare parts to allow for the prompt replacement of failed components and components which in its judgment need replacement.

12.4 The TSI shall replace a component that is subject to chronic failure and has been repaired three times or more, at BAIFA's option.

12.5 The TSI shall obtain the best competitive price for all spare parts and provide verification of this effort upon BAIFA's request.

12.6 The TSI shall present to BAIFA a listing of the current inventory on a quarterly basis. The format of this report is subject to approval by BAIFA.

13. Communication and Reporting

13.1 The TSI shall schedule and conduct monthly status meetings with BAIFA to inform BAIFA of the performance of the system, any problems noted and solutions.

13.2 The TSI shall submit all written communication to BAIFA or other interested parties via email (verbal communications shall be duplicated in email).

13.3 TCS failures list including all components, communication losses, security breaches, equipment theft, and issues as identified regardless.

13.4 The TSI shall develop and make available to BAIFA a series of reports defined below that provide information on all maintenance activities. The reports shall be presented in enough detail to be used for performance monitoring and shall be attached with each billing cycle. The TSI shall provide reports including but not limited to:

13.4.1 Monthly spare parts use report – detailing the use of spare parts for preventive or remedial maintenance; noting the number of repairs or replacements of high value parts and components that are identified by part and serial number.

13.4.2 Monthly spare parts inventory report – supporting the invoiced line item for spare parts ordered, received and successfully tested.

13.4.3 Monthly work order history report – detailing the following information:

13.4.3.1 Histogram showing the time between failures, time to respond and repair and total number of calls.

13.4.3.2 All on-call remedial work that will include, but is not limited to, a monthly listing of all calls indicating:

13.4.3.2.1 Specific date problem was reported;

13.4.3.2.2 Log number;

13.4.3.2.3 Action taken;

13.4.3.2.4 Date and time of completion;

13.4.3.2.5 Technician assigned;

13.4.3.2.6 Parts used; and

13.4.3.2.7 Open calls and calls exceeding the response time by priority according to the performance requirements.

13.4.4 Monthly maintenance activity status report – containing at a minimum a complete statement of work status.

13.4.5 Monthly actual to scheduled maintenance report – comparing actual maintenance to scheduled maintenance for the previous month and listing of maintenance activities scheduled for the upcoming month.

13.4.6 Monthly Read Point/Corridor, and Host availability report – summarizing the availability of each Read Point, Corridor, and Host server by Corridor facility. These shall contain, but are not limited to, the reports specified in Attachment C, Performance Requirements& Penalties.

13.5 The TSI shall submit software release documentation at least fifteen (15) days prior to any software release. BAIFA approval shall be required for all software changes prior to any software release.

14. End of Maintenance Period

14.1 At the end of the Maintenance Period, items such as spares inventory, manuals, licenses and any other requirements necessary for another maintenance contractor to assume maintenance shall be turned over by the TSI to BAIFA.

RFP APPENDIX 1: Attachment A-4

BAIFA
BAY AREA INFRASTRUCTURE FINANCING AUTHORITY

BAIFA Express Lane Network

Toll Collection System

DRAFT Business Rules

SUBJECT TO REVIEW AND REVISION BY BAIFA, OTHER GOVERNMENT AGENCIES, AND LEGAL COUNSEL

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Introduction & Purpose

This document contains the business rules by which the Bay Area Infrastructure Financing Authority (BAIFA) operates its Express Lane Program (ELP). The purpose of this document is to track and maintain BAIFA's Business Rules as a living document. When a business rule is changed, the document will be updated and a notation made in the respective business rule under the "Last Changed" column. Any general or additional notes will appear in the revision history.

Several acronyms and terms are used throughout this document. Please refer to Appendix 1 – Reference 1, the Glossary of Acronyms, Terms & Definitions, for further information.

Applicable Laws & Legislation

BAIFA, through agreement with the Metropolitan Transportation Commission (MTC), has the responsibility to develop, operate, and finance the ELP that was authorized by the California Transportation Commission (CTC). Many of the laws and regulations that apply to tolling of express lanes are identical to those that apply to other tolled facilities including the state-owned toll bridges (see California Code - Division 17: TOLL BRIDGES, TOLL FERRIES, AND TOLL ROADS [30000. - 31482.] Chapter 3: Toll Bridges, Toll Roads, and Toll Ferries Generally [30800. - 30902.] Article 2: Regulations [30840. - 30847.]). This section identifies two laws that affect the Express Lane Network (ELN) Business Rules in a broad fashion. Other applicable laws and regulations are noted with the associated specific ELN Business Rules.

Federal law specifies that the average operating speed on high-occupancy vehicle (HOV) lanes should be, at a minimum, 45 miles per hour (mph) 90 percent of the time over a consecutive 180-day period. The maximum traffic volume at which this speed can be reliably maintained on Bay Area HOV lanes is commonly assumed to be 1,600 vehicles per hour (vph), referred to herein as the operating capacity of the HOV lanes. (For exact wording, see Title 23, Section 166 of the U.S. Code.)

The express lane toll system must be compliant with Title 21 of the California Code of Regulations which establishes the technical requirements for Electronic Toll Collection (ETC) readers and transponders used in the State of California. This includes transponder/reader level compatibility with other California Toll Operators Committee (CTOC) agencies. It should be noted that discussions are under way to consider adding new tolling technologies to Title 21 (e.g., sticker tags).

Per California Streets and Highways Code, the express lanes must operate at Level of Service C or better, unless otherwise agreed upon by the California Department of Transportation (Caltrans) and BAIFA that Level of Service D is permissible. (For exact wording, see Section 149.5 and 149.7 of the California Streets and Highways Code.)

Roles & Responsibilities

Entity	Role	Responsibilities
Metropolitan Transportation Commission (MTC)	Lead Agency - Supplies Staff and Resources to BAIFA	Delegate authority and responsibilities to develop, procure, install, maintain, finance, and operate the ELN to BAIFA, through a cooperative agreement.
Bay Area Infrastructure Financing Authority (BAIFA)	ELN Operator and Overall Program Management and Project Delivery	Joint powers authority formed for the purpose of planning, developing, maintaining, and funding transportation and related projects, including express lanes. • Act as Express Lane Network Program Operator • Administer TSI agreement(s) • Monitor and report on express lane performance • Manage communications, marketing, and public outreach functions of the BAIFA-operated express lanes • Provide the reconciliation, accounting, and auditing functions for the ELN • Maintain the BATA and BAIFA Regional Communications Network which serves the express lane toll system • Oversee civil work • Coordinate with other express lane operators in the region and throughout the state
Bay Area Toll Authority (BATA)	Tolling Implementation and Operations	• Regional Customer Service Center (RCSC) operations – Oversee the RCSC contract and manage the FasTrak accounts • Procure FasTrak transponders • Implement backhaul communication network
MTC Service Authority for Freeways and Expressways (MTC SAFE)	Freeway Service Patrol (FSP)	MTC SAFE works in conjunction with CHP and Caltrans to implement various motorist aid programs.
Xerox	Incumbent RCSC Contractor	Contracted by BATA to develop, deliver, and maintain the RCSC.
California Highway Patrol (CHP)	Express Lane Enforcement	• Perform on-site enforcement of express lane eligibility • Lead response measures related to incidents • Provide enhanced enforcement for installation and maintenance activities • Assist with traffic control activities

Entity	Role	Responsibilities
Caltrans	Express Lanes Traffic Operations and Owner of State Highway Facilities	• Review and approve all plans, specifications, and estimates, design and traffic operation plans, including construction and maintenance activities within state right-of-way • Monitor the operation of the freeway and initiate corrective actions when needed to ensure motorist safety • Operate the District 4 Traffic Management Center (TMC) with the ability to request override of the express lane Variable Toll Message Signs (VTMS) • Control the regional Advanced Traffic Management System (ATMS) • Maintain all civil roadway elements of the express lanes • Monitor the performance of HOV lanes in accordance with statutory requirements • Operate and maintain the freeway performance measurement system (PeMS)
Toll System Integrator (TSI) (TBD)	Toll System Design, Development, Installation, Testing, Maintenance, and Operations	Contracted by BAIFA to implement, maintain, and operate the ELN Toll Collection System (TCS) and all tolling equipment.
TBD	Express Lane Roadway Operator/ Operations	• Monitor traffic sensor network on the ELN • Actively manage traffic to maintain maximum performance of the express lane Corridors • Change toll rates on a real-time basis • Monitor express lane activity and traffic conditions • Respond to incidents and issues using manual controls or system overrides provided through the ATMS and/or TCS Graphical User Interface (GUI)
TBD	Backhaul Maintenance Contractor	• Monitor, maintain, and repair the communications hardware, software, and service between the roadside network and TCS Host, and between the TCS Host and other systems that interface with the TCS

Entity	Role	Responsibilities
Alameda County Transportation Commission (ACTC), Contra Costa Transportation Authority (CCTA), Solano Transportation Authority (STA), and Santa Clara Valley Transportation Authority (VTA)	Congestion Management Agencies (CMA)	• Participate jointly with MTC, CHP, and Caltrans in the planning and delivery of express lane improvements for the MTC Program within their respective counties. The CMA may act as the lead for one or more phases of delivery (environmental, design, advertise and award, or construction) for the civil component of the express lanes. Except where noted below, the leads for specific phases have yet to be determined. • For express lanes that are owned and operated by ACTC or VTA, coordinate operations with those of the MTC-owned express lanes

Business Processes Overview

This section outlines the basic business processes that the express lane system will be designed to perform.

- *Transaction Creation:* The lane equipment uses Violation Enforcement System (VES) cameras and Automatic Vehicle Identification System (AVI) antennas to identify individual vehicles in tolling Zones and create Lane Transactions. The Host computer matches the individual Lane Transactions at each Read Point across tolling Zones to build a single Trip Transaction to send to the RCSC for posting to customer accounts.
    - **Identify vehicles at the Read Point**
    - **Create Lane Transactions at the point of detection (i.e., at the Lane Controller)**
    - **Create Trip Transactions at the Host**
    - **Transmit ELN Trip Transactions to RCSC**
- *Maintenance and Operations*: This function includes monitoring the health of the system, setting toll rates and operating hours, and monitoring monitoring. ELN operations also logs system performance and information technology (IT) issues. These functions are supported with reports, screens, and alerts.
    - **Calculate and display toll rates using Dynamic Pricing**
    - **Correct transactions**
      In the event of a traffic incident, this process allows express lane operators to correct the toll rate associated with a set of Lane Transactions. These corrections will be rolled up to correct the tolls associated with Trip Transactions. The process may occur prior to or after the system sends Trip Transactions to the RCSC.
    - **Monitor road operations**
      Both on an ongoing and a historical basis, BAIFA monitors toll rates and their effects on traffic movement in the express lanes and associated general purpose (GP) lanes. The system collects, stores, and reports on data to support this process.
    - **Monitor system performance**

Both on an ongoing and a historical basis, BAIFA monitors the performance of the TCS itself. This system collects, stores, and reports on data to support this process.

- *Auditing*: The auditing function includes reviewing controls and variances for the transaction creation and operations function. Data is collected, summarized, and analyzed to monitor for system and other variances to minimize revenue loss.
    - **Exception monitoring and control**
      The system will mark as exceptions Lane Transactions that it cannot associate with Trip Transactions and/or other exception conditions.
    - **Daily audit process**
      Daily electronic toll registrations are compared to the amounts recognized as revenue and deducted from the customers' prepaid accounts as reported by the RCSC to determine the integrity and accuracy of the electronic toll collection.
- *Accounting/Financial Reporting*: The financial reporting/accounting function includes financial reporting for BATA's revenue operations. The information processed here summarizes the revenue and traffic financial results.
    - **Revenue Day close**
      At the end of each Revenue Day, the system reports all Lane Transactions by Zone, all Trip Transactions by Corridor, and expected revenues for the Revenue Day by Zone, by Corridor, and by county and for the entire ELN. The system accounts for all transactions and consolidates the revenue into accounting periods by Revenue Day segments that roll-up into a Revenue Day. Proper cutoffs are a generally accepted accounting principles (GAAP) requirement.
    - **Confirm daily revenue**
      The purpose of this process is to allow Finance to confirm that all expected revenue for the Revenue Day is accounted for and reconciled to expected revenue sent to the RCSC. Finance also confirms that total expected ETC revenue reconciles to the total ETC postings reported by the RCSC. Finance examines all variances.
    - **Daily reporting of revenue and traffic**
      The purpose of this process is to recognize and record the daily toll revenue, both transponder and image-based, by Zone and by Corridor. The daily revenue data is used for financial reporting of all toll revenue.
    - **Monthly audit and revenue reporting process**
      Finance prepares monthly toll revenue reports for financial statements and various other reporting purposes. The system will summarize the revenue by Corridor and by county. The daily revenue data are consolidated into the monthly reports. The standard monthly production reports provide support to Finance's manual entries into the integrated financial and administrative solution (IFAS) accounting system and an overview of the monthly toll revenue integrity and trends. The monthly ELN reconciliation reports also provide an overview of internal controls, RCSC reconciliation information, and the average tolls applied for each Zone.

Business Rules

1. Using the Express Lanes

This section presents the business rules governing proper use of the express lanes by drivers. The assumption for this version of the ELN Business Rules is that the ELN will honor the same account types BATA honors.

1.1 Permitted Vehicles

BR ID	Rule	Last Changed
1.1.1	Only vehicles with two axles, including motorcycles, are permitted to use the express lanes. [Federal Surface Transportation Assistance Act of 1982 §§167, CVC §§21654]	
1.1.2	Any vehicle carrying a trailer or towing another vehicle, and vehicles with more than two axles, are not permitted to use the express lanes. [CVC §§21654]	
1.1.3	Regardless of weight and vehicle class restrictions, public and private buses are permitted to use the express lanes. Buses that do not meet MTC/BATA's definition of a "commute bus" must meet occupancy requirements and have a Switchable Transponder to receive HOV discounts. [See http://bata.mtc.ca.gov/tolls/schedule.htm]	
1.1.4	Vanpools (registered through Rideshare) that are not equipped with a non-revenue transponder must carry Switchable Transponders and meet occupancy requirements to receive HOV discounts.	
1.1.5	Vehicle classes that are not permitted in the express lanes will be charged a toll in accordance with the setting of their transponder (and toll violation penalties if applicable).	
1.1.6	All vehicles without transponders will be charged the single occupancy vehicle (SOV) toll (and violation penalties if applicable).	
1.1.7	Vehicles with paper dealer plates are required to carry a valid transponder to use the express lanes. Vehicles that do not have a transponder and are without registered license plates are subject to citation by the CHP.	
1.1.8	Vehicles with obstructed, improperly mounted, illegible, or missing plates are required to carry a valid transponder to use the express lanes. Vehicles with obstructed, improperly mounted, or illegible license plates that do not carry transponders are eligible for citation by the CHP.	
1.1.9	Inherently low emission vehicles (ILEV) (currently including partial zero emissions vehicles (PZEV) and compressed natural gas (CNG) vehicles) with any number of occupants (including single occupancy) receive the three or more passengers (HOV 3+) toll on the ELN, provided they display a valid white or green DMV-issued decal and carry a Switchable Transponder set to the HOV 3+ position. [Ref. CVC §§5205.5 and 21655.9.]	

1.2 Exempt Vehicles

BR ID	Rule	Last Changed
1.2.1	Authorized emergency vehicles are exempt from the requirement to pay a toll if, and only if, all of the following conditions are met: • The vehicle is properly displaying an exempt California license plate, and is properly identified or marked as an authorized emergency vehicle. • The vehicle is being driven while responding to an urgent or emergency call, or engaged in an urgent or emergency response. • The driver of the vehicle determines that the use of the toll facility shall likely improve the availability or response and arrival time of the authorized emergency vehicle and its delivery of essential public safety services. [Ref. CVC §23301.]	
1.2.2	Any vehicle granted toll-free travel on some or all of the ELN must be equipped with an agency approved and issued non-revenue transponder or have a license-plate based non-revenue account established. Non-revenue access to the express lanes does not guarantee toll-free travel on any other toll facility. Non-revenue access to any other toll facility does not guarantee toll-free travel on the BAIFA-operated express lanes.	

1.3 Access to the Lane

BR ID	Rule	Last Changed
1.3.1	The express lanes provide continuous access, in which access to the express lane is not restricted to designated locations. Instead, vehicles are able to enter and exit the express lane at any point designated by skip-stripe pavement markings.	
1.3.2	At designated locations, the ability to enter and exit the express lane may be restricted for safety or other operational reasons. Restricted access sections are designated by solid double stripe pavement markings to separate the express lane from the adjacent general purpose lanes. Solid double stripe pavement markings are illegal to cross and such maneuvers are enforceable by the CHP.	

1.4 Customer Pre-Enrollment

BR ID	Rule	Last Changed
1.4.1	All customers must enroll with the FasTrak RCSC for a registered account (FasTrak Account, License Plate Account, or One-Time Payment) prior to travelling the express lanes in order to avoid receiving a Violation Notice.	
1.4.2	Drivers who incur a toll and do not have a registered account eligible for posting the Trip Transaction at the time of travel will be issued a Violation Notice from the RCSC.	
1.4.3	FasTrak customers must equip their vehicle with a properly mounted transponder prior to travelling in the express lanes.	
1.4.4	Valid FasTrak Account holders travelling without a transponder but with their license plate listed on the account will be charged an Image Toll (ITOL) to their account.	

BR ID	Rule	Last Changed
1.4.5	All motorcycles are required to be equipped with a transponder. To receive the lowest HOV discounted toll,lmotorcycles are required to be equipped with a Switchable Transponder and should have the transponder switched to HOV 3+.	
1.4.6	The registered account must have either a sufficient prepaid balance or a valid credit card on file in order to be eligible for posting the Trip Transaction.	
1.4.7	Trip Transactions that post to a License Plate Account may incur an additional service fee (configurable at the RCSC).	
1.4.8	A Trip Transaction will be associated with an eligible registered account by either transponder ID or license plate number and state.	
1.4.9	Customers driving rental cars associated with plate-based FasTrak accounts may use the express lanes. Trip Transactions will post to the rental car account. It is the responsibility of the customer to check with the rental agency and to make sure they are opted in to use the rental toll payment program. Customers in rental cars are not eligible for HOV-tolled travel on the express lanes unless the rental car is equipped with a Switchable Transponder or the customer is traveling with a personal Switchable Transponder.	
1.4.10	Vehicles with metallic windshields should use a bumper mounted transponder or be registered with a License Plate Account. Vehicles with metallic windshields cannot receive the HOV discount.	

1.5 High Occupancy Requirements

BR ID	Rule	Last Changed
1.5.1	The high occupancy requirement for the ELN is two or more passengers (HOV 2+) in each permitted vehicle unless otherwise specified for a particular Corridor. [See http://rideshare.511.org/511maps/hov_lanes.aspx]	
1.5.2	Motorcycles are considered to be meeting HOV requirements on all facilities regardless of the occupancy required. [Title 23, United States Code (U.S.C.), Highways, §§102]	
1.5.3	Two-seater vehicles with two occupants are considered to be meeting HOV requirements on all facilities regardless of the occupancy required. [California Streets and Highways Code §§30101.8]	
1.5.4	Carpool requirements for carpool lanes on BATA bridges apply to the express lanes located at approaches to those bridges.	
1.5.5	To be eligible for HOV discounts, customers must have a Switchable Transponder properly installed in the vehicle and the switch must be set to the HOV eligible setting. Switchable Transponders allow customers to declare the number of occupants (1, 2, or 3+) by changing the transponder's switch position.	
1.5.6	Vehicles equipped with standard (non-switchable) transponders or with no transponder will be tolled at the SOV toll rate regardless of occupancy.	
1.5.7	Any vehicle with a Switchable Transponder set to a position indicating HOV status, but that does not have enough occupants to meet the HOV eligibility requirement, is subject to citation by CHP.	
1.5.8	The high occupancy requirement for a particular Zone when it is in HOV only	

BR ID	Rule	Last Changed
	operations is the same as the HOV requirement for that Zone during normal express lane hours of operation.	

2. Express Lane Operations

This section includes business rules for operating the express lanes, which includes managing the performance of the ELN, incidents, lane closures, and use of the dynamic message signs on the ELN corridors.

2.1 Express Lanes Hours of Operation

BR ID	Rule	Last Changed
2.1.1	Express lane tolling hours of operation must be concurrent with hours for which a HOV restriction is in effect. [Ref. California Streets & Highway code §§ 149.7] See Figure 1: Express Lane Hours of Operation	
2.1.2	During all other non-tolling hours, the express lanes are available for all vehicles to use toll-free as general purpose lanes and without any occupancy restrictions.	
2.1.3	No vehicle traveling in the express lanes outside the hours of operation will be charged a toll, even if the vehicle is carrying a transponder.	
2.1.4	During non-tolling hours, the system will continue to gather traffic information. Transponders may be read and license plates captured.	

2.2 Operational States

BR ID	Rule	Last Changed
2.2.1	During tolling hours, each Zone can be manually or automatically set to HOV only operations, where vehicles without the required number of occupants to qualify as HOV for the Corridor may not enter the express lanes.	
2.2.2	In HOV only operations, vehicles already in the express lanes that stay in the lane will be charged their locked-in toll rate.	
2.2.3	TBD: Rules for additional operational states and settings to be added here.	

2.3 Incidents

BR ID	Rule	Last Changed
2.3.1	Toll rates for a Zone can be manually overridden by the ELN operator during an incident.	
2.3.2	Toll rate corrections can be made for a specified timeframe for a Zone. All transactions that meet the criteria for the toll rate adjustment will have their toll rate corrected and toll recalculated.	

2.4 Image Capture

BR ID	Rule	Last Changed
2.4.1	Two rear images are captured at each Read Point.	
2.4.2	All images captured for a Trip Transaction will be available at the Host to resolve customer disputes received by the RCSC.	

BR ID	Rule	Last Changed
2.4.3	All images captured will be subject to BAIFA's retention policy and will comply with the BATA PII policy. [Ref. California Streets and Highways Code Sec. 31490]	

2.5 Variable Toll Message Sign Messages

BR ID	Rule	Last Changed
2.5.1	During normal operational state, each VTMS will display a maximum of two destinations and associated toll rates – the price to travel through the current Zone and the price to the end of the current Segment. If the customer is in the final Zone of the current Segment, only that price will be displayed.	
2.5.2	During normal operational state, customers will be locked into the prices displayed on the VTMS at or immediately prior to the first working Read Point at which they are detected (taking into account the case of offline Read Points immediately prior).	
2.5.3	During normal non-tolling hours, the VTMS will display "open to all".	
2.5.4	In HOV only operations, VTMS in that Zone or Segment and upstream of the Zone or Segment, will display "HOV only" for the Zone and for any Segment that includes that Zone.	
2.5.5	The messages displayed on the VTMS for other operational states are [TBD].	
2.5.6	In the event of a communications failure, affected VTMS will display default rates which are based on historical rates for the day of week and time of day.	
2.5.7	In the case a VTMS displays a partially or completely blank screen, that associated Read Point (for dual VTMS-Read Points, the Read Point at that sign or for standalone VTMS-Read Points, the Read Point(s) immediately after that but before the next VTMS) will not be included in the Trip Building.	
2.5.8	In the case where a VTMS displays a partially or completely blank screen for the entry point of a trip, during tolling hours, customers will be locked-in to the toll rate of the first following non-blank VTMS.	
2.5.9	Toll rates for bridges and other express lane facilities will not be included in rates displayed for BAIFA's express lanes.	

2.6 Traffic and Pricing Monitoring

BR ID	Rule	Last Changed
2.6.1	Express lane operators are responsible for monitoring in real-time: • Traffic conditions based on speed and volume, in the express lane and general purpose lanes • Tolling system equipment health status and real-time transactions at all Read Points (VTMS, Requirements Traceability Matrix , and Maintenance Online Management System) • Other information from the Caltrans TMC, television, websites (511.org), and radio • Corridors equipped with CCTV viewing, pan/tilt/zoom manipulation for traffic monitoring, and VTMS	

BR ID	Rule	Last Changed
2.6.2	Express lane roadway operations will be responsible for reporting on the performance of the roadway and tolling system including: • Key Performance Indicators • Roadway statistics • Trip Transactions	
2.6.3	Express lanes roadway operations is responsible for: • Traffic incident logging and corresponding toll rate adjustments (if any) • Dynamic Pricing/toll rate setting and override • Manual override of VTMS messages • Express lane mode changes, both automatic and manual	

2.7 Transponder Feedback

BR ID	Rule	Last Changed
2.7.1	Although transponders will continue to emit beeps on Bay Area bridges, a transponder will not emit a beep when a reader successfully detects it in the Express Lanes.	

2.8 Enforcement

BR ID	Rule	Last Changed
2.8.1	One or more beacons installed at each Read Point will illuminate for transponders set to the HOV level required for the Corridor or higher. CHP will monitor vehicles in the express lanes to verify those vehicles declared as meeting the HOV requirement actually meet occupancy requirements.	
2.8.2	After pulling a vehicle over, CHP will use a web portal to query the TCS for transponder ID and/or vehicle license plate to confirm whether customer declaration at the previous Read Points is consistent with observed vehicle occupancy.	
2.8.3	Each CHP officer must use their own unique login credentials when signing on to the web portal.	
2.8.4	After issuing a citation, a CHP officer may use the web portal to immediately email [encrypted] transponder or license plate number query results for court documentation.	
2.8.5	CHP will also enforce lane crossing restrictions, vehicle class, speed, dealer plate, no plate, and other traffic violations in-lane. Such enforcement has no dependence on vehicle occupancy or customer enrollment.	

2.9 Lanes Closures for Toll System Maintenance

BR ID	Rule	Last Changed
2.9.1	The express lanes may be closed as necessary to perform preventive and corrective maintenance on tolling equipment in the lane and on the roadside.	
2.9.2	Maintenance and traffic control activities will follow Caltrans' lane closure guidelines, procedures, and permitting.	

2.10 Performance Monitoring Reporting

BR ID	Rule	Last Changed
2.10.1	Performance monitoring business rules will be compliant with BAIFA operational goals, interagency cooperation, and federal and state requirements.	

3. Express Lane Pricing

The business rules in this section address all the aspects of setting and applying toll rates.

3.1 Toll Rate Determination (Dynamic Pricing Algorithm)

BR ID	Rule	Last Changed
3.1.1	Toll rates are dynamically priced using a demand management algorithm. The algorithm may consider express lane and general purpose lane traffic density and/or volumes and/or vehicle speeds to assess demand and determine the corresponding toll rate.	
3.1.2	The minimum toll rate allowed on the ELN during tolling hours can be set by Corridor, Segment, or Zone.	
3.1.3	If applicable, the maximum toll rate allowed on the ELN can be set by Corridor, Segment, or Zone.	
3.1.4	The Zone toll rate displayed to the public on VTMS signs shall be automatically updated no more frequently than every [TBD] minutes.	
3.1.5	The toll rate in any given Zone will not automatically increase or decrease by more than $[TBD] during any [TBD] minute period.	
3.1.6	The express lane can be set to automatically switch into HOV only operations based on speed, volume, or the toll rate calculated by the Dynamic Pricing algorithm to indicate that only carpool-eligible vehicles are allowed to use the express lane.	
3.1.7	When the express lane is set in HOV only operations, vehicles entering the express lanes but not meeting the occupancy requirement for the Corridor are charged the HOV only toll rate for each Zone travelled that is in HOV only operations.	
3.1.8	When the express lane is set in HOV only operations, vehicles already in the express lanes that are not meeting the occupancy requirement for the Corridor will be charged the locked-in rate for that Zone/Segment.	
3.1.9	The HOV 2+ and HOV 3+ toll rates are separately configurable as a percentage of the SOV toll rate. The percentages are also separately configurable by Corridor.	
3.1.10	Trip Transactions with an HOV toll rate of $0 will/will not (TBD) be sent to the RCSC for posting at $0 to the FasTrak account on which the transponder ID is listed. Trip Transactions associated with non revenue tags will be sent to the RCSC for posting.	
3.1.11	Trip Transactions with an HOV toll rate of $0 toll applied will/will not (TBD) appear on customer statements.	
3.1.12	If communication to a VTMS is down and the sign displays a historical toll rate, Trip Transactions originating in that Zone will get the lower price between the historical and real-time toll rate.	

BR ID	Rule	Last Changed
3.1.13	If it is unknown what rate is displayed on a VTMS, Trip Transactions originating at the associated Read Point would get the lower price between the historical and real-time toll rate.	
3.1.14	Toll rates will be rounded to the nearest five cents.	

3.2 Express Lane Definition (For definition of new Corridors, Segments, and Zones)

BR ID	Rule	Last Changed
3.2.1	Each Corridor contains one or more Segments (which separate 'major destinations'). Each Segment contains one or more Zones (or pricing sections). Each Zone contains multiple Read Points (where vehicles are detected by transponder and/or license plate number).	
3.2.2	Each Zone is approximately 3-5 miles in length (the length assumed during conceptual design and therefore the optimal length for the system).	
3.2.3	Zones should be (but are not required to be) kept in a single county.	

4. Trip Building

This section focuses on how Lane Transactions from Read Points are associated into Trips using the Trip Building process.

4.1 Trip Building

BR ID	Rule	Last Changed
4.1.1	Lane Transactions in the same direction of travel along a Corridor will be assembled into Trip Transactions and sent to the RCSC for posting to customer accounts or for generating Violation Notices (for non-registered license plates).	
4.1.2	No single Lane Transaction will be included in more than one Trip Transaction.	
4.1.3	If a customer exits the express lane and decides to get back in after the allowable travel time passes, two separate trips are constructed and the guaranteed price from the initial entry is considered expired.	
4.1.4	Lane Transactions received at the Host shall be associated to the same Trip Transaction if the Lane Transactions meet at least all of the following criteria: - Transponder ID, vehicle image, and/or license plate number identification sufficient for association - Geographically possible sequence of Read Points (for example, northbound progression) - Allowable travel time between Read Points (TBD: the allowable travel time may be defined differently for each Zone)	
4.1.5	A Zone will be included in a Trip so long as the number of Lane Transactions for the vehicle is at least the minimum required for that Zone (the minimum can be defined differently for each Zone).	

BR ID	Rule	Last Changed
4.1.6	If consecutive Zones qualify for inclusion in a Trip (based on a minimum number of Lane Transactions) and travel occurs within an allowable timeframe given distance and traffic speed, all Zones will be included in a single Trip.	
4.1.7	For vehicles with no transponder, the Lane Transactions will be associated to the same Trip if the license plate number(s) and/or vehicle image are determined to be for the same vehicle.	
4.1.8	If a transponder ID is detected at all Read Points during a vehicle's travel, a Trip Transaction will be formed based on the common transponder ID.	
4.1.9	If the same transponder ID is not detected at all Read Points, a Trip Transaction will be formed by mapping transponder ID, vehicle image, and license plate information from all the Lane Transactions.	
4.1.10	After the RCSC completes image review, it will reject some Trip Transactions because they overlap with each other and will send them back to the Host (see Section 5.2). With the new license plate information from the RCSC image review, the Host will combine these Trip Transactions in order to eliminate the overlaps. The Host will send these Rebuilt Trip Transactions to the RCSC for posting.	
4.1.11	Although the system will attempt to build and send only one Trip Transaction to the RCSC for vehicles carrying multiple transponders, it is the customer's responsibility to ensure only one transponder is in the vehicle. Vehicles with multiple transponders may be incorrectly charged for their Trips (double-charged or sent Violation Notices for lost/stolen transponders).	
4.1.12	Image Based Trip Transactions (no transponder ID associated with the Trip) are assigned a SOV determination and assigned the SOV toll.	
4.1.13	Standard and SOV-declared (at all Read Points) Switchable Transponder Trips are assigned an SOV occupancy determination and assigned the SOV toll.	
4.1.14	Switchable Transponder Trip Transactions with HOV 2+ declaration at all Read Points are assigned an HOV 2+ occupancy determination.	
4.1.15	Switchable Transponder Trips with HOV 3+ declaration at all Read Points are assigned an HOV 3+ determination.	
4.1.16	Switchable Transponder Trips with different switch settings within a single Trip will be assigned (TBD). *Options:* The lowest occupancy of all reads. For example, if a single Trip includes both HOV 2+ and HOV 3+ reads, the Trip is marked as HOV 2+ for pricing. If a Trip includes at least one SOV read, the Trip is marked as SOV for pricing. Configurable by (1) the percent of Read Points detected as HOV-declared, (2) the total number of HOV-declared Lane Transactions, (3) the number of times the switch position changes in a single Trip Transaction, (4) when the switch is made, (5) the order in which the customer changed the occupancy setting.	

4.1.17	The customer is responsible for ensuring that their license plate is not obscured. Obscured license plates could affect the ability of the system to properly build a Trip Transaction and assign the appropriate toll to the customer.	

4.2 Toll Rate Assignment

BR ID	Rule	Last Changed
4.2.1	Customers will be locked-in to (guaranteed) the toll rates displayed on the VTMS directly prior to or at the first Read Point recorded.	
4.2.2	The locked-in toll rates will apply from entry into the first Zone of the Trip Transaction through the last Zone of the Segment for that Trip.	
4.2.3	The locked-in toll rates will not change if the price goes up or down while the customer is still in the current Zone or Segment.	
4.2.4	The Trip Transaction toll is the sum of the locked-in toll rates for each Zone in the customer's Trip.	
4.2.5	A customer will be charged once for each Zone in a Trip so long as the vehicle was detected at the minimum number of Read Points in the Zone.	
4.2.6	When a vehicle continues into another Segment, it is locked-in for the new toll rates displayed on the VTMS directly prior to or at the first Read Point in the new Segment.	
4.2.7	Vehicles identified as having an HOV occupancy determination consistent with the Corridor's HOV occupancy requirement are assigned the HOV-discounted toll. SOV Trip Transactions are assigned the SOV toll.	
4.2.8	Trip Transactions with non-revenue transponders will be assigned a $0 toll regardless of operational state or Switchable Transponder declaration.	

4.3 Trip Transaction Communication to the RCSC

BR ID	Rule	Last Changed
4.3.1	No more than a single Trip Transaction shall be sent to the RCSC for every unique ELN Trip.	
4.3.2	Each transaction file sent to the RCSC will contain only ETC (tagged transactions) or Image Based Trip Transactions (IBTs) from a single Revenue Day.	
4.3.3	For Trip Transactions with a valid transponder, the Host will send the valid transponder number to the RCSC. (See Business Rule 3.1.10 for exceptions)	
4.3.4	For Trip Transactions without a valid transponder number (a negative balance, lost, or stolen transponder, or no transponder at all), the Host shall send the transponder number (if available), two images, and an overall confidence level for the Trip Transaction to the RCSC.	
4.3.5	For a Trip Transaction encompassing multiple Zones without a valid transponder number, the Host will send the image that is the most manually readable from the first Zone of the Trip, and the image that is the most manually readable from the last Zone of the Trip, to the RCSC.	
4.3.6	For a Trip Transaction covering only one Zone without a valid transponder number, the Host will send the two images that are the most manually readable from the Zone to the RCSC.	

BR ID	Rule	Last Changed
4.3.7	The license plate number identified by the toll system equipment for each of the images sent to the RCSC must match the license plate associated with the Trip Transaction after Trip Building. If either of the highest confidence images from the first or last Zone has a different optical character recognition (OCR) result, another image from that Zone that matches the Trip Transaction license plate number will be sent to the RCSC.	

5. RCSC System Processing

The ELN will use the BATA RCSC for processing all Trip Transactions, both those posting to customer accounts and those processing as violations (see Figures 2 and 3). This document includes a subset of the existing BATA RCSC Business Rules where applicable. ELN processing of Trip Transactions and IBTs will be processed according to BATA RCSC Business Rules unless otherwise specified in this document.

5.1 Customer Accounts

Account types and business rules surrounding those accounts types are already established at the RCSC.

BR ID	Rule	Last Changed
5.1.1	BATA bridges and express lanes will support the same account types. (Invoices will not be issued for Trip Transactions.)	
5.1.2	Authorized (BAIFA-approved) customers may use non-revenue transponders on the ELN.	
5.1.3	The RCSC will send a final status update for Trip Transactions that post to an account, are paid (i.e., violations), or are rejected at the RCSC. The RCSC will communicate these final statuses using reason codes and posting amounts.	

5.2 Trip Transaction Processing

BR ID	Rule	Last Changed
5.2.1	The RCSC will wait until all images are reviewed for an associated set of Trip Transactions before posting to accounts. Sets of Trip Transactions will be associated by time periods.	
5.2.2	During the processing of a set of Trip Transactions, the RCSC will check for any overlap between two or more Trip Transactions posting to the same account. If the RCSC finds overlap between two or more Trip Transactions in a set, these overlapping Trip Transactions are all rejected with an "overlapping" reason code. Otherwise, RCSC posts the Trip Transaction. (Overlapping Trip Transactions are Trip Transactions containing one or more identical zones occurring within a configurable time of each other).	
5.2.3	If the RCSC performed image review on an overlapping Trip Transaction, the License Plate information from the image review will be sent back to the Host with the Trip Transaction reconciliation information.	
5.2.4	The RCSC will not be required to have logic that checks for "separated" Trip Transactions. Separated Trip Transactions are made by a vehicle whose single trip has been separated into different Trip Transactions because they have no Zones in common. The RCSC will post both Trip Transactions, and customer inquiries will be handled on a case-by-case basis.	

5.3 Customer Statements

BR ID	Rule	Last Changed
5.3.1	Travel on separate express lane Corridors will result in separate Trip Transactions posting to customer accounts and appearing as separate Trip Transactions on customer statements.	
5.3.2	Bridge approach ELN Trip Transactions will appear as a separate Trip Transactions from the bridge toll and other express lane Trip Transactions on customer statements.	
5.3.3	Customer statements should include Trip start point, end point, start time, total Trip toll, and added fees (where applicable).	
5.3.4	Customer statements will identify BAIFA as a distinct agency issuing Trip Transactions and will appear with transactions from other agencies that post to FasTrak accounts.	
5.3.5	Customer statements will identify the Corridor(s) and direction associated with each Trip Transaction line item.	

5.4 RCSC Fare Corrections and Exception Processing

BR ID	Rule	Last Changed
5.4.1	The toll assessed for any Trip Transaction can be changed or reversed through a correction file from the ELN Host.	
5.4.2	Manual toll reversals and adjustments can be applied by an RCSC customer service representative (CSR) upon request from the customer and determination by the CSR of less than desirable level of service for the subject Trip, based on BAIFA ELN Business Rules.	
5.4.3	An RCSC CSR can manually apply a toll reversal without case-by-case escalation to, and approval by, the agency so long as the dispute meets criteria specified in the dispute matrix provided by BAIFA to the RCSC.	

5.5 Violation Processing

The express lane violation processing is based on existing violation processing for BATA toll bridges. This section clarifies important similarities and differences, but does not define all business rules for existing BATA violation processing.

BR ID	Rule	Last Changed
5.5.1	Images for Trip Transactions with no valid transponder will be sent to manual image review if they are not received with sufficient OCR confidence (configurable threshold) to bypass manual review.	
5.5.2	There is no ‘grace period’ prior to issuance of a Violation Notice. Hence, if no valid customer account exists for the license plate number and/or transponder ID associated with an express lane Trip Transaction at the time the RCSC receives and processes it, the Trip Transaction will go to violation processing.	
5.5.3	Post-registration (of either a FasTrak or License Plate Account) will not prevent receipt of a Violation Notice for the Trip.	

BR ID	Rule	Last Changed
5.5.4	Violation Notices are sent to the registered owner's name and address on file with the California Department of Motor Vehicles (or other US state with an agreement in place).	
5.5.5	All Trip Transactions posted at the RCSC on the same Revenue Day will be sent one Violation Notice.	
5.5.6	No bridge violations will appear on the same Violation Notice as any express lane Trip Transaction.	
5.5.8	Each Violation Notice will include a $XX [TBD] penalty for each Trip Transaction, in addition to the assigned toll.	
5.5.9	For each Trip Transaction unpaid XX [TBD] days after the Violation Notice, a delinquent penalty of $XX [TBD] will be applied—for a total fee amount of $XX [TBD] per Trip Transaction.	
5.5.10	A DMV registration hold may be placed on a California license plate with Violation Notices unpaid beyond the delinquent notice due date. The registered owner of the vehicle will be required to pay all outstanding tolls, penalties, and fees in order to renew the vehicle registration. Escalation to a DMV registration hold includes an additional $X [TBD] fee per unpaid Trip Transaction. A collection agency may also be used for delinquent violation notices.	
5.5.11	If a customer post-registers the license plate with a new or existing valid account and back-dates the plate effective date to the Trip Transaction date or earlier, the toll amount only will be applied to the account and all penalties will be waived.	
5.5.12	If the license plate number associated with a Violation Notice is successfully matched to a FasTrak account, then the toll amount only will be applied to the customer's account and all penalties waived.	
5.5.13	If a valid account held by the RCSC does not have sufficient funds for the posting of an Image Based Trip Transaction, the Trip Transaction will be sent to violation processing, and penalties may be charged.	

5.6 Image Processing

BR ID	Rule	Last Changed
5.6.1	An overall confidence level of 98%, or the confidence level to be determined based on an acceptable error (e.g. 5 errors in 1000), shall be required at the RCSC for an ELN image to be processed without image review, i.e. any image with an overall confidence level of 98% or higher shall not be subject to "manual" image review.	
5.6.2	If a license plate requiring image review cannot be identified using the two images provided and according to image review rules, the Trip Transaction is rejected and does not attempt to post to an account or generate a Violation Notice.	
5.6.3	Once the license plate number is identified (with or without manual review), the RCSC will attempt to match the plate to a valid account. If this cannot be done, the Trip Transaction is sent to violation processing.	
5.6.4	[TBD – Rule on how the RCSC selects images on the Violation Notice.]	

6. Customer Contact & Support

BR ID	Rule	Last Changed
6.1.1	General customer service inquiries and account related questions (registration, management, and express lane Trip Transactions) will be directed to the RCSC.	
6.1.2	BAIFA will provide the RCSC with a matrix of policies and procedures for handling disputes and dispute escalations to the agency.	

7. Financial & Accounting Operations

Standard reporting mechanisms and associated business rules for reconciling transactions, payments, and bank deposits are more thoroughly documented in the RCSC. Business rules within this section identify mechanisms that specifically relate to express lanes.

7.1 Revenue Recognition and Processing

BR ID	Rule	Last Changed
7.1.1	All transactions shall be accounted for and assigned a unique transaction identifier.	
7.1.2	Each Revenue Day is equal to a calendar day.	
7.1.3	Trip Transactions will be assigned to Revenue Days according to the entry time associated with that Trip.	
7.1.4	File exchange reports will show the data and time file transferred to the RCSC, files acknowledged by the RCSC, and response files sent back to the RCSC. This includes both ETC and IBT files.	
7.1.5	Posted revenue will be reported by posted date and business date and by account types including ETOL, ITOL, CTOC, LTOL, ONETOL, and VTOL.	
7.1.6	Host will compare expected ETOL revenue with ETOL revenue posted at the RCSC by Revenue Day, and identify all variances.	
7.1.7	Host will compare expected IBT revenue with ITOL, VTOL, LTOL and ONETOL revenue posted at the RCSC to calculate IBT revenue.	
7.1.8	CTOC revenue shall be reported the same as Trip Transactions posted to an account held by the RCSC.	
7.1.9	Non-revenue Trip Transactions and Trip Transactions with $0 tolls due to HOV status shall be reported separately.	
7.1.10	Revenue from every Zone must be associated with one or more counties.	

7.2 Adjustments and Corrections

BR ID	Rule	Last Changed
7.2.1	Adjustments and other exception processing may only be performed by authorized personnel.	
7.2.2	Authorized personnel will be able to access a range of transactions to adjust or reverse by one or more Zones and by Trip Transaction date and time.	
7.2.3	When making an adjustment, users must enter a comment regarding the reason for the adjustment.	
7.2.4	BAIFA will recognize these adjustments based on Trip Transaction date.	

BR ID	Rule	Last Changed
7.2.5	When the system records buffered transponder Trip Transactions during a time when the lane has continued to take images, these Trip Transactions will not be released for processing.	
7.2.6	Revenue from late Trip Transactions will be processed by the system.	

7.3 Revenue Day Audit Review

BR ID	Rule	Last Changed
7.3.1	Auditor will review: • Variance reports and trends after the Revenue Day • Exception Trip Transactions, adjustments or reversals, and variances with the RCSC • Daily settlement amount • Monthly reports	

Appendix A

Figure 1 – Express Lane Hours of Operation (as of August 9, 2013)

Corridor	Day of Week	Operating Hours
I-880 (Alameda)	Monday - Friday	5:00AM-9:00AM; 3:00PM -7:00PM
I-680 (Contra Costa)	Monday - Friday	5:00AM-9:00AM; 3:00PM -7:00PM
SR-84 (Alameda)	Monday - Friday	5:00AM-10:00AM; 3:00PM -7:00PM
SR-92 (Alameda)	Monday - Friday	5:00AM-10:00AM; 3:00PM -7:00PM
I-80 (Solano)	Monday - Friday	5:00AM-10:00AM; 3:00PM -7:00PM

Note: High occupancy requirements for each Corridor may be found at http://rideshare.511.org/511maps/hov_lanes.aspx.

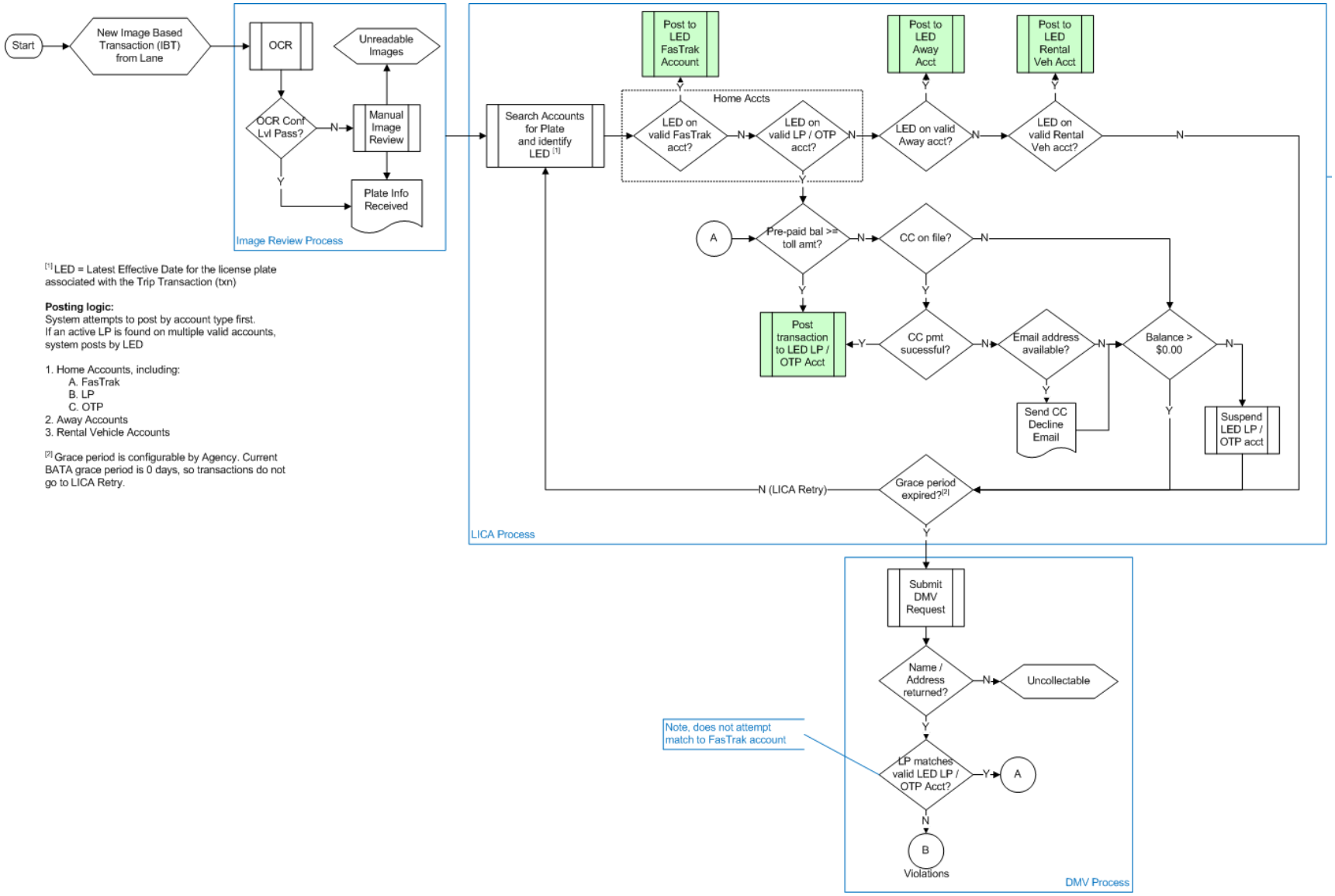

Figure 2 – RCSC Image Based Transaction Processing

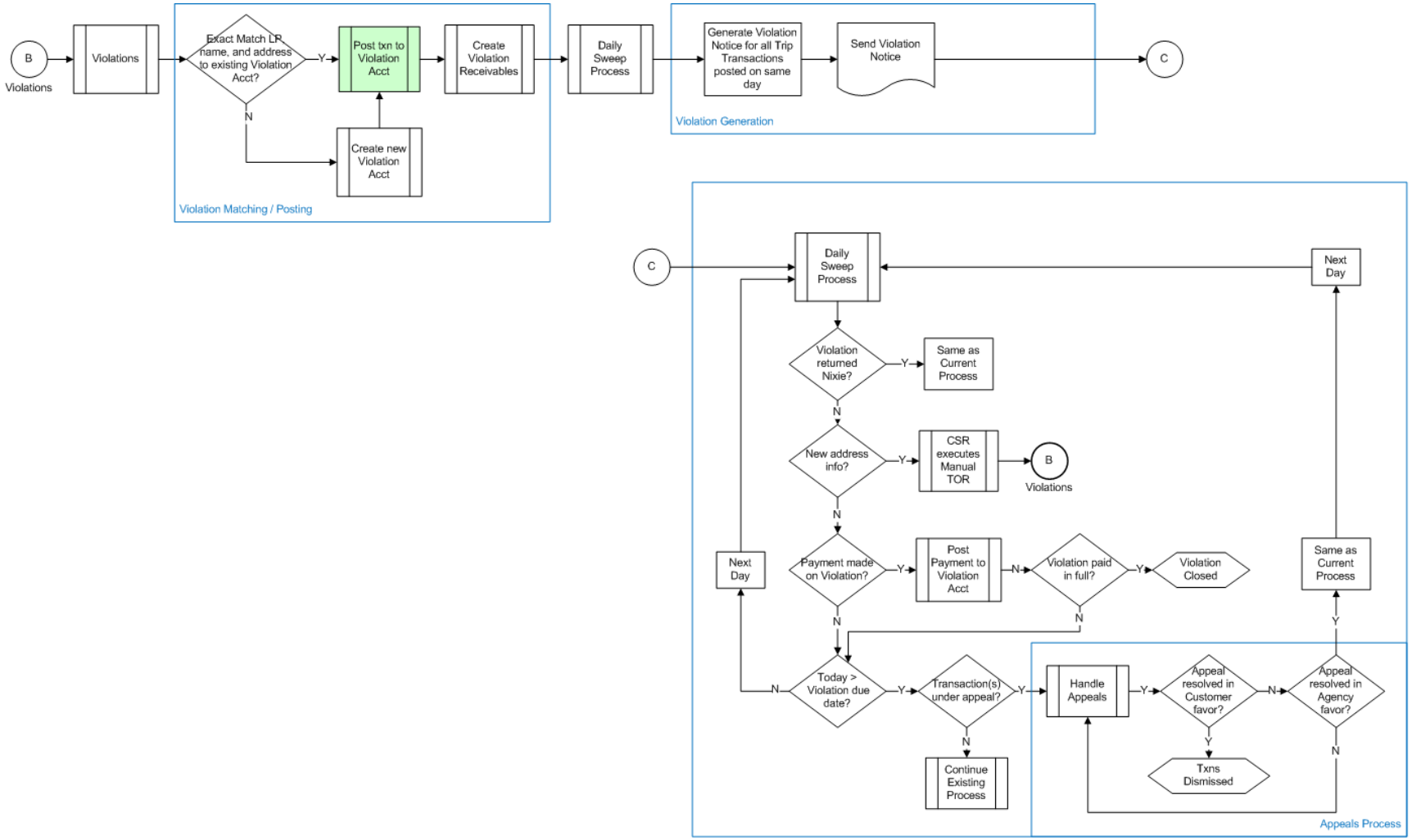

Figure 3 – RCSC Violation Transaction Processing

RFP APPENDIX 1: Attachment B

BAIFA
BAY AREA INFRASTRUCTURE FINANCING AUTHORITY

BAIFA Express Lane Network

Toll Collection System

Schedule and Project Milestone Dates

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Schedule & Project Milestones

The TSI shall implement the Express Lane Network (ELN) system in accordance with the Milestones listed in Table 1, Implementation Payment Milestones. The Toll System Integrator's (TSI) schedule shall meet the Guaranteed Completion Date or an accelerated date. Where applicable, the TSI shall submit proposed Guaranteed Completion Dates for approval using the project schedule update, submittal, review and approval process (See Attachment A-2, Implementation Requirements).

1. Program Phasing Summary

The Bay Area Infrastructure Financing Authority (BAIFA) ELN program shall commence with notice to proceed (NTP) on the first series of Milestones shown in Table 1. Once the initial program-level planning and development are complete, implementation and maintenance will be phased in Corridor by Corridor with some activities being performed in parallel. Figure 1: Corridor Phasing on Page 6 shows the preliminary schedule for Corridor deployment.

2. Project Schedule

Project schedules shall be created, submitted, and approved in accordance with Attachment A-2, Implementation Requirements, Section 1.3.5. Schedules submitted by the TSI are not valid until expressly approved by BAIFA.

3. Qualifying Events & Guaranteed Completion Dates

The TSI shall obtain BAIFA's written approval for all Qualifying Events and associated deliverables reflected in Table 1 by their Guaranteed Completion Date. In order to obtain BAIFA's final written approval, every deliverable and Qualifying Event associated with a Milestone shall undergo the submission and review process outlined in Section 1.3.8 of Attachment A-2, Implementation Requirements.

In the event that the TSI does not meet a Guaranteed Completion Date for a Tolling Commencement Milestone, liquidated damages shall be assessed in accordance with the Agreement.

In the event that the TSI does not meet the Guaranteed Completion Date for an Operations Test, as shown in the most current, approved project schedule, BAIFA may assess penalties for failure to meet performance requirements as soon as the Guaranteed Completion Date for the Operations Test has passed. Applicable penalties are listed in Attachment C, Performance Requirements & Penalties.

4. Implementation Payment Milestones

Note that Table 1 below uses *working days*; the TSI shall provide the project schedule(s) in working days.

An asterisk indicates that the TSI shall obtain a notice to proceed from BAIFA in order to commence work on the associated Milestone. The TSI's schedule shall reflect dates for BAIFA review and approval of predecessors, qualifying events, and deliverables that align with completion on the Guaranteed Completion Date.

In addition to the qualifying events shown, the following items must be approved for each Milestone to be completed:

1. All Monthly Progress Report(s) for reporting periods that end prior to this Milestone's guaranteed date;

2. All monthly Approved Project Schedules per Section 1.3.5 of Attachment A-2, Implementation Requirements; and

3. All monthly Bill of Materials Tracking Reports per Section 4.5 of Attachment A-2, Implementation Requirements.

Table 1: Implementation Payment Milestones

#	Milestone Name	Qualifying Event	Guaranteed Completion Date
Milestone Series 1: Program Development			
1-1	Project Initiation*	Project Management Plan (PMP) Critical Path Method Schedule Updated Subcontractor Management Plan Project Initiation Conference Quality Management Plan (QMP) Project Communications Plan Safety Plan	7/31/14
1-2	Requirements Refinement	Document Requirements Trace Matrix Updated System Design Work Plan Software Development Plan (SDP) Security Plan	*TSI Scheduled Date*
1-3	Preliminary Design Approval	Preliminary Design Document Updated Requirements Trace Matrix Functional Demonstration Plan	12/18/14
1-4	Critical Design Approval	System Design Document (SDD) Updated Requirements Traceability Matrix OmniAir Certification Services' ISO 18000-6C Certification Report	3/12/15
1-5	Other Plans	Master Test Plan FAT Detailed Test Plan Master Installation & Cutover Plan Disaster Recovery Plan	*TSI Schedule Date: Minimum of 30 days prior to the commencement of FAT*
1-6	Factory Acceptance Test (FAT)	FAT Test Report	7/16/15
Milestone Series 2: I-680 (First) Corridor Deployment			
2-1	I-680 Installation Readiness*	OFIT Detailed Test Plan Communications End-to-End Test Plan I-680 Installation & Cutover Plan Installation Drawings Traffic Control Plan VTMS Installation Report Any Applicable Permits or Licenses	8/13/15
2-2	Onsite First Installation	Site Commissioning Test Plan	10/8/15

#	Milestone Name	Qualifying Event	Guaranteed Completion Date
	Test (OFIT)	Zone Detailed Test Plan OFIT Test Report Communications End-to-End Test Report	
2-3	Disaster Recovery Installation	Installation Plan Installation Drawings Traffic Control Plan Disaster Recovery Detailed Test Plan	*TSI Scheduled Date Minimum of 10 days prior to Tolling Commencement*
2-4	I-680 Site Commissioning Tests 1 through 5	Site Commissioning Test Reports	*TSI Scheduled Date*
2-5	I-680 Site Commissioning Tests 6 through 10	Site Commissioning Test Reports	*TSI Scheduled Date*
2-6	I-680 Site Commissioning Tests 11 through 15	Site Commissioning Test Reports	*TSI Scheduled Date*
2-7	I-680 Remaining Site Commissioning Tests and End-to-end Test	All Site Commissioning Test Reports Zone Test Report Full Corridor Detailed Test Plan Full Corridor Test Report Disaster Recovery Test Report End-to-end Detailed Test Plan End-to-end Test Report Operations Test Plan Maintenance Plan	*TSI Scheduled Date: Minimum of 10 days prior to Tolling Commencement*
2-8	Training	User Manuals Maintenance Manuals Training Manuals and Completion of Training Courses	*TSI Scheduled Date: Minimum of 10 days prior to Tolling Commencement*
2-9	I-680 Tolling Commencement		3/17/16
2-10	Operations Test	Operations Test Report As-Built Installation Drawings As-Built System Design Document Host Software Source Code and Documentation	*TSI Scheduled Date: Maximum of 60 days after Tolling Commencement*
Milestone Series 3: I-880 Corridor Deployment (In combination with SR 92 San Mateo Bridge Approach and SR 84 Dumbarton Bridge Approach)			
3-1	I-880 Installation Readiness*	Incremental Design (shop drawings, etc; site specific changes from baseline design approval) I-880 Installation & Cutover Plan Installation Drawings Traffic Control Plan Any Applicable Permits or Licenses	3/31/16
3-2	Incremental & Regression Test	Incremental Detailed Test Plan Incremental Test Report	*TSI Scheduled Date*

#	Milestone Name	Qualifying Event	Guaranteed Completion Date
		Regression Test Report Updated Site Commissioning Test Plan	
3-3	I-880 Site Commissioning Tests 1 through 5	Site Commissioning Test Reports	*TSI Scheduled Date*
3-4	I-880 Site Commissioning Tests 6 through 10	Site Commissioning Test Reports	*TSI Scheduled Date*
3-5	I-880 Site Commissioning Tests 11 through 15	Site Commissioning Test Reports	*TSI Scheduled Date*
3-6	I-880 Site Commissioning Tests 16 through 20	Site Commissioning Test Reports	*TSI Scheduled Date*
3-7	I-880 Site Commissioning Tests 21 through 25	Site Commissioning Test Reports	*TSI Scheduled Date*
3-8	I-880 Site Commissioning Tests 26 through 30	Site Commissioning Test Reports	*TSI Scheduled Date*
3-9	I-880 Site Commissioning Tests 31 through 35	Site Commissioning Test Reports	*TSI Scheduled Date*
3-10	I-880 Site Commissioning Tests 36 through 40	Site Commissioning Test Reports	*TSI Scheduled Date*
3-11	I-880 Site Commissioning Tests 41 through 45	Site Commissioning Test Reports	*TSI Scheduled Date*
3-12	I-880 Remaining Site Commissioning Tests and End-to-end Test	All Site Commissioning Test Reports Full Corridor Detailed Test Plan Full Corridor Test Report Updated Operations Test Procedures Completion of Additional Training or Documentation Updates including User Manuals	*TSI Scheduled Date: Minimum of 10 days prior to Tolling Commencement*
3-13	I-880 Tolling Commencement		3/16/17
3-14	I-880 Operations Testing	As-Built Installation Drawings As-Built System Design Document Operations Test Report Host Software Source Code and Documentation	*TSI Scheduled Date: Maximum of 30 days after Tolling Commencement*
Milestone Series 4: I-80 Corridor Deployment			
4-1	I-80 Installation Readiness*	Incremental Design (shop drawings, etc; site specific changes from baseline design approval)	3/16/17

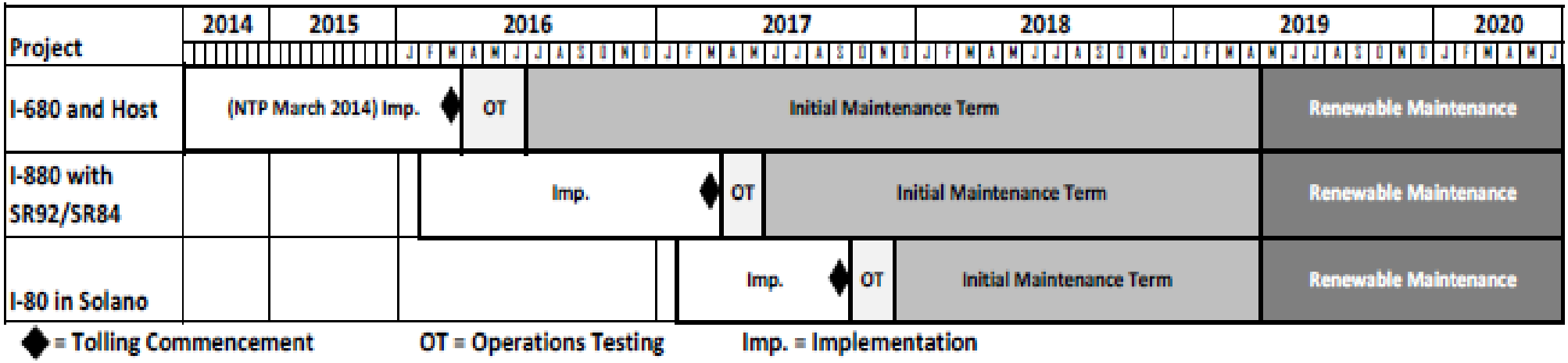
#	Milestone Name	Qualifying Event	Guaranteed Completion Date
		I-80 Installation & Cutover Plan Installation Drawings Traffic Control Plan Any Applicable Permits or Licenses	
4-2	Incremental & Regression Test	Incremental Detailed Test Plan Incremental Test Report Regression Test Report Updated Site Commissioning Test Plan	*TSI Scheduled Date*
4-3	I-80 Site Commissioning Tests 1 through 5	Site Commissioning Test Reports	*TSI Scheduled Date*
4-4	I-80 Site Commissioning Tests 6 through 10	Site Commissioning Test Reports	*TSI Scheduled Date*
4-5	I-80 Site Commissioning Tests 11 through 15	Site Commissioning Test Reports	*TSI Scheduled Date*
4-6	I-80 End-to-end Test	All Site Commissioning Test Reports Full Corridor Detailed Test Plan Full Corridor Test Report Updated Operations Test Procedures Completion of Additional Training or Documentation Updates including User Manuals	*TSI Scheduled Date: Minimum of 10 days prior to Tolling Commencement*
4-7	I-80 Tolling Commencement		9/21/17
4-8	I-80 Operations Testing	As-Built Installation Drawings As-Built System Design Document Operations Test Report Host Software Source Code and Documentation	*TSI Scheduled Date: Maximum of 30 days after Tolling Commencement*
Milestone Series 5: Phase 1 Express Lane Network System Acceptance			
5-1	System Acceptance	Completion Certification for all Contractual Deliverables and Milestones All project documentation specified in the Agreement Host Software Source Code and Documentation	4/30/18

* Notice to proceed (NTP) from BAIFA is required for the TSI to commence work on this Milestone.

5. Monthly Maintenance

The TSI shall provide maintenance on a monthly basis in accordance with Attachment A-3, Maintenance and Warranty Requirements. The maintenance period for each Corridor shall commence with the approval of the Operations Testing Implementation Payment Milestone.

Figure 1: Corridor Phasing



RFP APPENDIX 1: Attachment C

BAIFA
BAY AREA INFRASTRUCTURE FINANCING AUTHORITY

BAIFA Express Lane Network

Toll Collection System

Performance Requirements and Penalties

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Introduction & Purpose

This document sets forth the Performance Requirements for the Toll Collection System (TCS). The Performance Requirements are set as the minimum level of performance against which the TCS will be measured during the warranty and maintenance periods of the Agreement.

Regardless of whether or not a Corridor maintenance period has begun, BAIFA will assess penalties for failure by the Toll System Integrator (TSI) to comply with the Performance Requirements beginning 60 working days after Tolling Commencement on the first Corridor, and 30 working days after Tolling Commencement on each subsequent Corridor.

Toll Collection System Capacity Requirements

Per Attachment A-1, System Requirements, the TCS must have the ability to read, transmit, process and store data at the volumes and rates to meet these performance requirements. This information is duplicated in Table 1 for reference:

Table 1: Toll System Capacity and other Minimum Requirements

ID	Description	Capacity/Measure
Per Read Point / Per Lane		
	Vehicles (Lane Transactions) per Hour	2,200 minimum
	Vehicles (Lane Transactions) per Day	50,000 minimum
	Vehicle Speed (to meet all standards)	0 mph to 100 mph
	Vehicle Separation (to meet all standards)	2 ft. minimum
Express Lane Host (Tier 1 Projects)		
	Lane Transactions per Day	1,520,000 minimum
	Trip Transactions per Day	380,000 minimum
	Trip Processing Time (hours within the same calendar day as first Read Point Lane Transaction)	3 hours maximum

1. Measurement & Applicability

1.1 Performance Requirements are defined as a Minimum Performance Measure.

1.2 The Read Point Performance Requirements shown in Table 2 shall apply:

1.2.1 During any active period during tolling hours.

1.2.2 To all vehicles, including motorcycles, multiple axle vehicles, and vehicles pulling trailers.

1.2.3 To vehicles traveling through a single or a multiple lane Read Point, including vehicles straddling lanes or traveling up to two feet into either shoulder (i.e. express lane vehicles).

1.3 The TCS shall successfully display the correct toll rate information to all Variable Toll Message Signs (VTMS) as described in Attachment A-1, System Requirements.

1.4 The TCS shall include the tracking of all vehicles as described above in Section 1.2.2 and shall be capable of reporting any vehicle traveling on the Express Lane Network (ELN) for all Read Points.

1.4.1 Record and report errors to the Host.

1.4.2 Report all performance measures and deficiencies.

1.5 System Reporting

Performance Requirements shall be automatically calculated and reported for any specified configurable period, which will initially be set to one day. The calculation shall be based on information automatically or manually entered into the Host computer comparing the actual parameter to the recorded parameter. Errors may be determined directly from Regional Customer Service Center (RCSC) reconciliation records, by observation, or inference based on historical information.

1.6 Table Definitions

The Requirements tables include the following column definitions:

- **Area:** The category to which this Performance Requirement and penalty applies.
- **Performance Requirement:** The requirement to be met by the TSI or TCS.
- **Minimum Performance Measure:** The quantification of the measurement for the Performance Requirement. This will translate into the time, frequency or accuracy of the area.
- **Measurement:** The time, frequency, and method of measurement. This also denotes the reporting and reporting date requirements.
- **Measurement Period/Increment:** This definition indicates the frequency or the increment of the measurement. If the measurement process is daily and the report is monthly, the TSI shall provide a cumulative method to quantify the area and requirement in a report.
- **Penalties:** The amount assessed for failure to meet or comply with the Performance Requirement and the limitations to the penalties.
- **Functions:** The following definitions are for the numbers used in the Functions column in Tables 4 and 5.
    - Essential Roadside System (1) – Essential Roadside System are those functionalities and lane equipment or communications whose failure will result in the inability to collect revenue, accurately create Lane Transactions, or properly audit.
    - Support Roadside System (2) – Support Roadside System are those functionalities and lane equipment or communications not included under essential Roadside System, which suffer failure.
    - Essential Host Functions (3) – Essential Host functions are those functionalities and Host equipment or communications whose failure will result in the

inability to collect revenue, accurately create Trip Transactions, or properly audit.

- Support Host Functions (4) – Support Host functions are those functionalities and Host equipment or communications not included under essential Host functions, which suffer failure.

1.7 Stop Clock Conditions

1.7.1 At BAIFA's discretion, the TSI may be excused from its obligation to meet the Performance Requirements under certain conditions that shall be referred to as “Stop Clock Conditions.” Only the time during which such conditions are present shall be excluded from the timeframes used to measure the TSI’s performance as set forth below:

1.7.1.1 PG&E electrical power disruption lasting more than three hours.

1.7.1.2 Loss of Backhaul Network availability, limited to the affected Toll Collection System functionalities dependent on the Backhaul Network.

2. Toll Collection System Performance Requirements

Upon automatic completion of Operational Testing, Performance Requirements and associated penalties for non-compliance of the Performance Requirements by the TSI or the TCS shall immediately take effect. The Performance Requirements for the TCS appear in Tables 2 and 3 below.

Table 2: Read Point Accuracy and Performance

No.	Area	Performance Requirement	Minimum Performance Measure	Measurement	Measurement Period/Increment	Penalties
2.1	Read Point	Date/Time Synchronization: All components of TCS shall be time-synchronized by the Host to within 1/10 of a second to correctly synchronize all parts of all lane and trip transactions, images and video.	1/10 Second	Daily Process Monthly System Log (Submit with the progress report) TSI to provide report mechanism	Per component per hour	$100 per component per hour that the device is not synchronized - up to $10,000 per day
2.2	Lane Transactions	The TCS shall ensure that no Lane Transactions shall be lost even when associated with periods when communications with the Read Point is not available.	Zero Lane Transaction Loss	Daily Process Monthly Summary Report (Submit with the progress report) TCS integrity reports shall be reconciled daily to assure that no Lane Transactions are lost during the non-zero toll rate periods. (TSI to provide report mechanism) In cases where there is communication interruption with the host all Lane Transactions shall be reconciled immediately upon restoration of connectivity.	Per item over 30 day period	$5 per item - up to $10,000 per day
2.3	Read Point Lane Controller	Accurately detect cars and separate vehicles, assign correct Electronic Toll Collection (ETC) reads and images, and properly associate the data to a Lane Transaction at the minimum performance measure.	99.9%	Daily Process per Read Point Monthly Summary Report (Submit with the progress report) The TCS shall report the number to get 99.9% of accurately detected parameters of Lane Transactions per Read Point in a day.	Per month	$5 per vehicle less than Minimum Performance Measure - up to $10,000 per day
2.4	Read Point Lane Controller	Accurately detect and separate motorcycles, assign ETC reads and images, and properly associate the data to a Lane Transaction at the minimum performance measure.	50%	Periodic Monitoring (Ad-hoc) using Digital Video Auditing System (DVAS) Results Reporting (Submit with the progress report) Measurements to be capable of being audited by DVAS or other means.	Per Day	$5 per vehicle less than Minimum Performance Measure, vehicle mismatch in classification - up to $10,000 per day
2.5	Image Capture	Capture human readable rear license plate images as defined in Appendix 1, Attachment A-1 Section 6.1, where both the plate number and the US state of registration are discernible.	99%	Daily Process Monthly Summary Report (Submit with the progress report) The TCS shall report the performance measure of capturing human readable images of the correct vehicle where both plate number and US state are discernible.	Per month	$5 per vehicle less than Minimum Performance Measure - up to $10,000 per day

No.	Area	Performance Requirement	Minimum Performance Measure	Measurement	Measurement Period/Increment	Penalties
2.6	Occupancy Enforcement Beacon	The TCS shall illuminate the occupancy enforcement beacon as defined in the System Requirements at each Read Point for all express lane vehicles meeting TCS Business Rules (e.g. Switchable Transponder set to HOV 3+ occupancy).	99.9%	Ad-Hoc Monitoring Results Reporting (Submit with the progress report) Periodic check. Errors in triggering the occupancy enforcement beacons shall be able to be monitored through the use of the CCTV or other means to verify the operation remotely. The TSI shall provide the mechanism to easily audit the Trip processing time of all Trip Transactions.	Per vehicle	$5 per vehicle for failure to trigger the occupancy enforcement beacon - up to $10,000 per day
2.7	Traffic Monitoring System (TMS)	The TMS shall correctly quantify traffic at all times at every data collection location.	±10% of TMS traffic parameter	Ad-hoc: TSI shall supply Lane Transaction data for ad-hoc selected periods via the Host. TMS traffic parameters shall be compared to field collected parameters. The TSI shall provide the mechanism to easily audit TMS data.	Per ad-hoc test	$5000 per hour outside the Minimum Performance Measure - up to $10,000 per day
2.8	Variable Toll Message Sign (VTMS)	The TCS shall post the correct toll rate(s) and messages on the VTMS.	99.99% of the time	Ad-hoc: TSI shall provide posting error reports through the Host.	Per ad-hoc test	$5000 per hour outside the Minimum Performance Measure - up to $10,000 per day

Table 3: Host Accuracy and Performance Transaction Processing

No.	Area	Requirement	Minimum Performance Measure	Measurement	Measurement Period/Increment	Penalties
2.9	Toll Host	No Loss of Trip Transactions: The TCS shall ensure that no Trip Transactions will be lost even when associated with periods when communications with the RCSC is not available.	Zero Loss	Daily Process Monthly Summary Report (Submit with the progress report) TCS integrity reports shall be reconciled daily to assure that no Trip Transactions are lost. (TSI to provide report mechanism)	Per Trip Transaction over a 30 day period	$5 per lost Trip Transaction - up to $10,000 per day
2.10	Toll Host	Storage: The TCS shall retain all data on-line per the System Requirements	See System Requirements	Monthly Process Monthly Summary Report (Submit with the progress report) TCS reports shall be run on a monthly basis to confirm all data is being retained for the durations per the System Requirements. TCS reporting to commence with start of live operations.	Per month	$1,000 per Month for each month that the storage is insufficient to maintain per the System Requirements
2.11	Trip Transaction	Trip Transaction accuracy: The Host shall correctly correlate all Lane Transactions related to each vehicle, barring Lane Transactions containing vehicles with no license plates and no transponder, into a single Trip Transaction and assign the correct toll rate to the Trip Transaction for that vehicle.	99.9%	Daily Process Monthly Summary Report (Submit with the progress report) Mismatched Trip Transaction reports shall be reconciled daily to assure that each vehicle shall generate only a single Trip Transaction per vehicle. (TSI to provide reporting mechanism)	Per instance	$5 per misreported Trip Transaction - up to $10,000 per day
2.12	Trip Building	Trip Processing Time: The time from the last Lane Transaction to building the final Trip Transaction shall be no more than three hours. Rebuilt Trip Transactions shall be formed within three hours from receiving new license plate information from the RCSC	3 Hours	Daily Process Monthly Summary Report (Submit with the progress report) The TSI shall provide the mechanism to easily audit the trip processing time of all Trip Transactions.	Per Trip Transaction	$5 per Trip Transaction over three hours up - to $10,000 per day
2.13	Trip Building	Trip Building Automation: Trip Building shall automatically form no less than 98% of Lane Transactions into Trip Transactions prior to sending to RCSC, barring Lane Transactions containing vehicles with no license plates and no transponder.	98%	Daily Process Monthly Summary Report (Submit with the progress report) The TSI shall provide the mechanism to easily audit the Trip Building automation.	Per Lane Transaction	$5 per Lane Transaction – up to $10,000 per day
2.14	Automatic License Plate Reader (ALPR)	At least 80% of the total human readable images shall be identified by the TCS as having a correct ALPR rate of at least 98%.	98%	Ad-hoc: TSI shall supply Lane Transaction data for ad-hoc selected periods via the Host. Use Host reporting tools to check image review and code-off results.	Per day	$1,000 per day - up to $10,000 per month

3. Operation Equipment Availability and Maintenance Response Requirements

Upon automatic completion of Operational Testing, Performance Requirements and associated penalties for non-compliance of the Performance Requirements by the TSI or the TCS shall immediately take effect. The Performance Requirements for the Equipment Availability & Maintenance appear in Tables 4 and 5 below.

Table 4: Operational Equipment Availability

No.	Area	Requirement	Functions	Minimum Performance Measure	Measurement	Measurement Period/Increment	Penalties
3.1	Host	Host Availability: Must meet the minimum performance period.	Essential (3)	99.99%	Daily Process Monthly Summary Report (Submit in the progress report) Host system availability will be the aggregate average of all components. Availability is measured by subtracting all unscheduled downtime from 100% available time and divide by 100% available time. Unit of measure shall be in percent. Monthly availability reports shall include cumulative totals for all Host scheduled and unscheduled down time. The start time of this calculation shall be at the beginning of warranty and shall go through the end of maintenance. The TSI shall track and report as part of the reporting process.	Per Day	$5,000 per Day commencing at the point TCS unavailability exceeds 0.01% and continues at a rate of $5,000 per Day for each subsequent Day until the TSI has presented evidence that the system has stabilized and BAIFA has signed off.
			Support (4)	95%			
3.2	Roadside Communications Network	Roadside Network communications shall be available 98% of the time per day	All	98%	Monthly Summary Report (Submit with the progress report) Using MOMS data, identify all downtime periods in each 24-hour period (one day) in a month, divided by the total months.	Monthly	$500 after the first 28 minutes (2% of minutes per day) that communication is down and $500 for each subsequent hour communication is down within a 24 hour period - up to $10,000 per day
3.2	Toll Collection System Availability	Toll Collection System Components Availability	Essential (3)	99.99%	Monthly Summary Report (Submit with the progress report) Using MOMS data, identify all downtime periods in each 24-hour period (one day) in a month, divided by the total months.	Monthly	$500 after the first 28 minutes that communication is down and $500 for each subsequent hour communication is down within a 24 hour period - up to $10,000 per day
			Support (4)	95%			

Table 5: Maintenance Response Requirements

No.	Maintenance Area	Requirement	Functions	Response Times (Measured by MOMS)	Measurement	Measurement Period/Increment	Penalties
3.3	Host Maintenance	Host maintenance. Coverage – 24 hours a day, 7 days a week	Essential (3)	Maximum time to respond – 2 hours Mean time to repair – 2 hours	Per Incident Monthly Activity Report (Submit with the progress report) Continuous MOMS Measurement - TCS reports shall verify maintenance work response and completion time.	Per Incident	$1000 per incident - up to $10,000 per month.
			Support (4)	Maximum time to respond – 4 hours Mean time to repair – 24 hours			
3.4	Roadside Equipment Maintenance	Roadside Equipment maintenance. Coverage – 24 hours a day, 7 days a week	Essential (1)	Maximum time to respond – 2 hours Mean time to repair – 2 hours Tolling hours required response – 1 hour Tolling hours required repair – 1 hour	Per Incident Monthly Activity Report (Submit with the progress report) Continuous MOMS Measurement - TCS reports shall verify maintenance work response and completion time.	Per Incident	$1000 per incident - up to $10,000 per month.
			Support (2)	Maximum time to respond – 4 hours Mean time to repair – 24 hours			
3.5	Other Maintenance	Other maintenance not covered in 3.3 and 3.4. Coverage – 24 hours a day, 7 days a week	Essential (1,3)	Maximum time to respond – 2 hours Mean time to repair – 2 hours Tolling hours required response – 1 hour Tolling hours required repair – 1 hour	Per Incident Monthly Activity Report (Submit in the progress report) Continuous MOMS Measurement - TCS reports shall verify maintenance work response and completion time.	Per Incident	$1000 per incident - up to $10,000 per month.
			Support (2,4)	Maximum time to respond – 4 hours Mean time to repair – 24 hours			
3.6	MOT Maintenance	Properly established maintenance of traffic pursuant to Implementation Requirements: The full width of the traveled way shall be open for use by public traffic between the hours of 5AM and 8PM all week. This is not applicable when the BAIFA or Caltrans requests that the closure remain in place beyond the scheduled pickup time.	N/A	Proper traffic control and timely reopening of the roadway Monthly Activity Report (Submit by 5th day of following month)	For each 10-minute interval, or fraction thereof past the time specified to reopen the closure.	Per Incident	Mainline 1st half hour = $2,100 / 10 minutes 2nd half hour = $3,100 / 10 minutes 2nd hour and beyond = $4,100 / 10 minutes Ramp 1st half hour = $1,000 / 10 minutes 2nd half hour = $1,000 / 10 minutes 2nd hour and beyond = $1,000 / 10 minutes Penalties are limited to 5 percent of total project cost per occurrence.
3.7	Timely Reporting	The TSI is required to provide accurate reports on the specified date to meet the reporting requirements.	N/A	Report Due Dates	Per Report submitted no later than the due date.	Per Report Per Specified Due Date	$1,000 per failure to submit report by the specified report date and $100 per day for each day thereafter that the report is late - up to $10,000 per month.