Southbound I-680 Smart Carpool Lane Concept of Operations

Submitted to:

Alameda County Congestion Management Agency

Submitted by the Partnership Team of:

Wilbur Smith Associates

ENGINEERS PLANNERS ECONOMISTS

IBI GROUP

URS

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March 2006

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ACCMA	Alameda County Congestion Management Agency
BATA	Bay Area Toll Authority
AMS	Account Management System
AVI	Automatic Vehicle Identification
CAD	Customer Account Database
CALTRANS	California Department of Transportation
CHP	California Highway Patrol
CCTV	Closed-Circuit Television
CSR	Customer Service Representative
CMS	Changeable Message Signs
DMS	Dynamic Message Sign
DSRC	Dedicated Short Range Communication
FHWA	Federal Highway Administration
ETC	Electronic Toll Collection
ETS	Electronic Toll System
FAQ	Frequency Asked Questions
GUI	Graphical User Interface
HOT	High Occupancy Toll
HCM	Highway Capacity Manual
HOV	High Occupancy Vehicle
HTML	Hypertext Markup Language
IVR	Interactive Voice Response
JPA	Joint Powers Agency
LOS	Level Of Service
LTD	Largest Traffic Density
MER	Mobile Enforcement Reader
MPH	Miles Per Hour
MTBF	Mean Time Between Failure
NSF	Non Sufficient Funds
PDF	Portable Document Format
PIN	Personal Identification Number
RCSC	Regional Customer Service Center
RF	Radio Frequency
ROW	Right of Way
RSE	Roadside Equipment
SOV	Single Occupant Vehicle
SR	State Route
TD	Traffic Density
TMC	Traffic Management Center
TDC	Toll Data Center
TP	Transaction Processor

TPS	Transaction Processor System
TZ	Tolling Zone
TZC	Tolling Zone Controller
VDS	Vehicle Detection System
WAN	Wide Area Network

1. EXECUTIVE SUMMARY

In order to provide better traffic flow on I-680 in Alameda County, a southbound high occupancy vehicle (HOV) lane will be converted to a High Occupancy Toll (HOT) lane. The Project Limits are from just south of the State Route (SR) 84 Interchange near Pleasanton to just south of Calaveras Boulevard (SR 237) in Milpitas. The HOT lane is part of the Southbound I-680 Smart Carpool Lane Project. The California Legislature under AB 2032 and the Federal Highway Administration (FHWA) authorized this conversion as a pilot project to improve travel efficiency in the corridor and provide more options to individual travelers. The Alameda County Congestion Management Agency (ACCMA) has been tasked and authorized to convert the existing HOV lane in the southbound direction to a HOT lane. The ACCMA along with the Alameda County Transportation Improvement Authority (ACTIA) and the Santa Clara Valley Transportation Authority (VTA) has formed the Sunol Smart Carpool Lane Joint Powers Authority to administer and operate the I-680 HOT lane. This conversion project is referred to as the Southbound I-680 Smart Carpool Lane (Smart Lane) Project. The California Department of Transportation (Caltrans) is responsible for the design and construction of the Southbound I-680 Standard HOV Lane.

I-680 was selected for this project because it is expected to experience significant traffic congestion during the morning peak period at the time in which the project will be opened to traffic. Conversion of the I-680 corridor HOV lane to the Smart Lane will be accomplished utilizing proven technology, traffic engineering expertise, and the concept of dynamic pricing with the goals of more efficiently using existing roadway capacity to improve traffic flow and travel times in the corridor and of optimizing revenue for future transportation and transit operational improvements in the corridor.

Currently, the southbound HOV lane allows continuous access for eligible vehicles to and from the mixed-flow (MF) lanes. In addition, the current southbound HOV lane serves as a mixed-flow lane during off-peak travel periods. Under the new configuration all eligible users (HOVs, motorcycles, buses and toll-paying SOVs) will be able to access the Smart Lane at designated locations during the hours of operation. HOV vehicles will continue to use the Southbound I-680 Smart Lane for free.

Solo drivers who want a more convenient and reliable trip can choose to use the Smart Lane for a fee. The fee that is charged will vary depending upon the traffic operating conditions in both the Smart Lane and the MF lanes. Two-axle, delivery-type trucks will also be allowed to use the new converted facility for a fee, but trucks with 3 or more axles will not be allowed to use the Smart Lane. This HOT lane concept has been successfully deployed in San Diego and Orange County, California as well as Houston, Texas and Minneapolis, Minnesota.

Under this Smart Lane concept:

- The new Smart Lane is designed to operate 24 hours a day, 7 days a week, in the southbound direction. However, the final decision on operating hours has not yet been determined. State legislation requires that the hours of the Smart Lane be consistent with the operating hours of the HOV lane.

- The assessed toll will be dynamically adjusted based on real-time traffic levels in both the Smart Lane and the MF lanes to ensure that Smart Lane traffic flow will be maintained at Level of Service (LOS) “C” or a LOS “D,” with Caltrans approval.
- The toll price will be posted on highly visible dynamic message signs (DMSs) which will be located upstream from the entrances to the Smart Lane allowing single occupant vehicle (SOV) motorists to choose whether or not to use additional capacity in the lane for the posted toll rate.
- Static signs will clearly identify the entrance and exit points of the Smart Lane.
- The tolling operation will be fully electronic, with no means for cash payments for each trip.

2. INTRODUCTION

Implementation of the southbound Smart Lane is expected to provide four important benefits to the motoring public in the region:

1. Carpools, express buses, motorcycles and selected other eligible vehicles will continue to be able to use an efficiently operating HOV lane for free;
2. The I-680 Smart Lane will add a limited number of toll-paying SOVs to the converted lane. The number of additional SOVs will be controlled by the amount of the toll that is dynamically calculated;
3. The new lane will provide SOV drivers with a new option of paying for a faster, more reliable trip during the times when it is important and necessary for them to arrive at their destination sooner; and
4. The toll revenue generated by the Smart Lane will help pay for operation and maintenance of the facility and for other transportation and transit improvements in the corridor.

This section provides an overview of the corridor and key aspects of the future Smart Lane operation. It discusses the current problems associated with growing traffic congestion on I-680, existing law enforcement and traffic management capabilities, a concept for the proposed Smart Lane electronic toll system (ETS), the opening and management of customer accounts, and the marketing of the system to the traveling public.

2.1 I-680 SOUTHBOUND TRAFFIC PROBLEMS

In September 2003, the ACCMA completed the *Interstate 680 Value Pricing Feasibility Study* (Study). The Study found that traffic congestion on I-680 continues to grow. During the morning peak hours of 6:00 A.M. to 9:00 A.M., segments of the southbound lanes of I-680 became congested and dropped below a LOS “D”. The Study was prompted by severe traffic congestion experienced during the late 1990’s economic “boom”. The existing HOV lane is currently underutilized during the morning peak-traffic period by both carpools and transit vehicles. These conditions could result in increased driver frustration and slower travel times in the corridor. The excess HOV lane capacity could be utilized in a more effective manner by allowing SOVs to use the HOV lane for a fee.

2.2 REACTION OF I-680 USERS TO THE CONCEPT OF SMART LANES

During the preparation of the Study, public reaction to the Smart Lane was sought through focus groups and a public opinion poll. The focus group participants supported the Smart Lane as an option to improve the current and future traffic operations of I-680. The idea of dynamic pricing and of collecting tolls utilizing a FasTrak transponder and electronic toll collection (ETC) system was perceived as fair by the focus group participants, especially if excess revenue could be used to fund additional transit service and improvements in the corridor.

In general, corridor users polled for the Study indicated they would be willing to pay a fee ranging anywhere from $0.25 for the shortest segment to $7.00 for the entire length of the Smart Lane, with $7.00 being the maximum per trip rate. On the basis of what was learned from these focus groups, the I-680 Smart Lane concept outlined in this document appears to be highly marketable.

2.3 I-680 SMART LANE MANAGEMENT AND TECHNOLOGY SOLUTIONS

The primary goals of the I-680 Smart Lane Project are to:

1. Better utilize the HOV lane to improve traffic throughput in the corridor; and
2. Optimize this new revenue stream to help pay for transportation improvements and transit operations in the corridor.

Presented below are several important issues pertaining to the Smart Lane conceptual development, management and technology solutions that are under consideration.

Traffic Management and Law Enforcement. Traffic management and law enforcement for the I-680 corridor are already in place, including a Traffic Management Center (TMC) co-located with the Maintenance Dispatch Center in Oakland and a California Highway Patrol (CHP) dispatch center located in Vallejo. The TMC provides maintenance dispatch, CHP dispatch and traffic operations management, utilizing a minimum number of closed-circuit television (CCTV) cameras for off-site observation of traffic patterns.

The CHP will enforce compliance with Smart Lane regulations. Various enforcement tools will be utilized by the CHP, including FasTrak transponder detection light beacons at the tolling zones, mobile enforcement readers and hand held enforcement devices. It is expected that a higher level of enforcement of the Smart Lane by the CHP will be required. The additional enforcement costs will be funded by the JPA using toll revenue.

Technology. The overall toll system will be owned and operated by the JPA and will consist of the roadway equipment, the Toll Data Center (TDC), central processing components, and various system enforcement tools. The system will manage traffic on the Smart Lane through dynamic toll rate setting. This will be accomplished through the near real-time monitoring of traffic flow in the Smart Lane and in the MF lanes to establish appropriate toll rates to either encourage or discourage SOV use of the lane.

Under the proposed Smart Lane concept, the targeted Smart Lane LOS will be maintained at level "C" or better with the implementation of the following proposed technology solutions:

- Dynamic pricing will control the toll rate based on the level of congestion in the Smart Lane and in the MF lanes. Toll rates will increase as the traffic in the Smart Lane increases and will be assessed based upon levels of congestion in the MF lanes;

- The number of access points to and from the Smart Lane will be limited to pre-designated locations;
- Approximately 12 traffic monitoring locations will be used along the southbound I-680 Smart Lane to continually monitor traffic density and speed in the Smart Lane and travel time information in the MF lanes;
- The technology configuration will involve the use of Dynamic Message Signs (DMSs) that will display the current toll rate ahead of the Smart Lane access points;
- A communication network will be implemented to support the Roadside Equipment (RSE) sites that read FasTrak transponders. The RSE sites, which are also referred to as Tolling Zones, will be equipped with a Tolling Zone Controller (TZC). The TZC, which will include a computer, will manage the transponder detection process (ETC antennas and readers), vehicle detection, system communications, data collection at each tolling zone, data storage and the periodic transmission of tolling zone data to the TDC;
- The Transaction Processor (TP) subsystem will reside at the TDC and will merge individual transaction records into single, one-way trips;
- The TDC will collect the tolling zone ETC transactions, develop trips from the transaction records and transfer toll trip data from the I-680 Smart Lane system to the Bay Area Toll Authority (BATA) Regional Customer Service Center (RCSC) for FasTrak account processing. Smart Lane trip data will be sent on, at least, a daily basis. BATA would then provide payment to the JPA based upon the toll payments that are embedded in the Smart Lane trip records that were sent for processing.
- Tolls will be collected through the use of FasTrak transponders and account management services will be performed by BATA's RCSC. The RCSC will handle FasTrak account management activities, distribution of transponders, payment processing, security/access and other ETC system financial functions; and

Back Office Processing by BATA. The FasTrak RCSC is located in San Francisco and is operated by BATA. Prospective customers are able to open a FasTrak account and secure a transponder in person, by phone, mail or through the BATA website using a credit card, check or cash. The same methods of account payment will be offered to the I-680 Smart Lane customers.

The RCSC provides a complete customer account and relationship management capability including automated interactive telephone system, state of the art account management and statement preparation, correspondence and document management, etc. BATA customer service representatives (CSRs) are trained in efficient account management, problem solving and customer relationship management. All customer calls pertaining to the FasTrak program will be fielded by BATA RCSC customer service staff. All FasTrak program questions will be answered by the BATA CSRs and any Smart Lane operations related questions will be transferred to the TDC so they can be handled by the JPA CSRs. JPA CSRs will be able to query Smart Lane FasTrak account information, in a read-only manner.

Smart Lane (FasTrak) customers will have the ability to manage their accounts on-line via the BATA account management system (AMS). This secure business management system is a fully integrated system used to manage toll revenue accounting, customer accounts and communications, FasTrak transponder inventory, reporting requirements and customer service through a web-based interface. The JPA will institute their own website that will describe the I-680 Smart Lane system and operations. The JPA website will contain a link that will allow people to access the BATA website to offer them an opportunity to join the FasTrak program or query their FasTrak account. The BATA website will contain a link that will allow motorists access to the JPA website so they can learn about the Smart Lane operation, policies and business rules.

Changes to the Existing HOV Lane. The Smart Lane will change the current continuous access HOV lane into a controlled access facility. Both HOV and toll-paying SOVs must enter and exit the Smart Lane at defined points. In addition, the proposed 24/7 operation will mean that access to the Smart Lane is controlled 24 hours a day. Currently the HOV lane is open to mixed-flow traffic during non-peak hours.

2.4 MARKETING THE I-680 SMART LANE

The marketing of the I-680 Smart Lane will define the unique experience of using the new service and include user perceptions about the ease of use, safety, reliability and customer service. The details of the marketing program will be provided in a Marketing Plan that will consist of an analysis of marketing conditions, definition of the market and audience, and a key issues outline. The Marketing Plan will also establish a mission and objectives for the marketing program and likely recommend an integrated campaign supported by media and advertising.

3. CURRENT SYSTEM

3.1 EXISTING FACILITY CONDITIONS

3.1.1 Overview

In September 2003, the ACCMA completed the *Interstate 680 Value Pricing Feasibility Study* (Study). This Study formed the basis for requesting and securing state legislation (AB 2032, Dutra 2003) to construct the Smart Lane as a pilot project. The Study analyzed Smart Lane operations in Years 2000 and 2025 for a no-build/HOV only condition and two build alternatives. Given the current economy in Silicon Valley, the traffic along the corridor has not yet returned to the Year 2000 levels, which is a probable level for the Smart Lane opening, which is expected to be late 2009. Year 2000 is considered an acceptable equivalent to a 2010 forecast. FHWA is agreeable to this approach since:

1. The project is considered a pilot with a limited statutory life span of 4 years from the date that tolls are first collected;
2. The Statute requires an evaluation of performance within 3 years of opening; and
3. The Smart Lane will be the first of its kind in California so data is not available to improve the accuracy of the current traffic forecast.

The Study's traffic analysis of the corridor's average morning peak-traffic period in the southbound direction indicates fewer than expected vehicles are currently using the new HOV lane. This level of HOV use leaves capacity in the lane that can be utilized by toll paying SOVs and, thereby, improve both their travel time as well as that of the MF vehicle operators.

3.1.2 Major Interchanges

There are three major interchanges along the I-680 corridor that introduce a significant amount of traffic to the corridor. These interchanges are at Mission Boulevard North (SR 238), the Auto Mall Parkway and Mission Boulevard South (SR 262). During the morning peak hours, a large volume of traffic enters the southbound lanes at these points as many of these motorists are traveling to jobs in Southern Alameda County and the Silicon Valley.

3.1.3 Off-Peak Conditions

During off-peak hours all southbound lanes of I-680 operate below capacity, therefore, there are no significant congestion problems.

3.2 TRAFFIC MANAGEMENT SYSTEM

The Oakland-based Caltrans TMC's primary purpose is to integrate Caltrans' incident, maintenance and construction dispatch with the CHP dispatch into a unified communications center. This integration provides the necessary communications and computer infrastructure for coordinated transportation management on the region's roads during normal commuting periods, during special events and when major incidents occur. The TMC, which is operated by Caltrans, collects data about existing road and traffic conditions using intelligent transportation system methods and a variety of hardware, including vehicle detection stations (VDSs) that will be installed along the I-680 Smart Lane corridor.

The current plans are to have ramp metering and other traffic operational and monitoring elements deployed along the I-680 corridor by Caltrans. In addition, Caltrans plans to have a limited number of changeable message signs (CMSs) installed along the I-680 corridor as part of the HOV improvements.

3.3 LAW ENFORCEMENT

Based upon input from the CHP, current enforcement levels for the I-680 HOV lane is equivalent to the HOV lane enforcement levels in the Bay Area. This operation is managed out of the Dublin CHP office.

4. CONCEPTS FOR THE I-680 SMART LANE SYSTEM

4.1 PROJECT LIMITS

The project will cover the length of the existing southbound I-680 HOV lane, which currently extends about 14 miles from just south of the State Route (SR) 84 Interchange near Pleasanton in the north to just south of Calaveras Boulevard (SR 237) Interchange in Milpitas in the south. The Smart Lane access points will be limited to increase vehicle throughput, improve enforcement, and simplify the electronic tolling system.

4.2 DYNAMIC PRICING

4.2.1 Introduction

The goal of the Smart Lane is to allow the unused capacity of the HOV lane to be used by SOV drivers paying a toll without compromising the use of the Smart Lane by carpools, transit vehicles, motorcycles and other eligible vehicles. SOV passenger vehicles and 2-axle trucks, up to a maximize weight of 10,000 pounds, will be allowed to use the Smart Lane for a fee if there is available capacity in the lane to sell.

The number of SOVs entering the Smart Lane must be carefully and continuously managed in order to keep the traffic flowing at an LOS of "C" or better. SOV access to the Smart Lane will be controlled through the adjustment of the toll. The toll rate will be calculated based upon the level of service in the Smart Lane and the travel time in the MF lanes. Toll rates will increase as traffic increases in the Smart Lane and as travel times increase in the MF lanes to regulate the number of vehicles entering the Smart Lane and thereby maintain a LOS "C" or better. Conversely, as HOV demand decreases and travel times decrease in the MF lanes, the toll rate will be adjusted downwards to optimize operation in the Smart Lane and to allow more SOV motorists to "buy in" to use the additional capacity of the Smart Lane.

The approach to utilize the Smart Lane traffic density and speed data as well as travel time information from the MF lanes will allow the JPA to assess toll rates that reflect the estimated time savings for choosing to use the Smart Lane. This new and innovative toll rate setting approach will ensure that SOV patrons of the Smart Lane pay a fair amount for their associated time savings.

As the SOV motorist approaches an entry point to the Smart Lane, a DMS will display the current toll rate for use of the lane. At each Smart Lane entry point, one or two specific rates will be displayed on the DMS to inform the motorist what toll amount will be assessed if they travel either to an intermediate exit or to the end of the facility. If the SOV motorist enters the Smart Lane, the toll amount observed on the sign will be the maximum paid regardless of any rate changes that might occur while the motorist is utilizing the lane. The toll rate is "locked in" for each SOV motorist based upon the point and time of entry.

Approximately 12 VDS locations will be deployed in the Smart Lane and in the MF lanes. The data gathered from these VDSs will be used to assess the levels of congestion in both the Smart Lane and the MF lanes and to then calculate the appropriate toll rate. The Smart Lane system toll calculation is described below.

4.2.2 Traffic Demand Pricing Calculation

The LOS targeted for the Smart Lane is "C", as defined in the *Highway Capacity Manual (HCM)*, which is published by the Transportation Research Board (TRB). Based upon the HCM, data from the *Interstate 680 Feasibility Study, September 2003,* indicates that at peak times approximately 550 vehicles per hour per lane travel at speeds higher than 55 miles per hour in the HOV lane. This translates to a LOS "B."

The assessment of the LOS is based upon the Traffic Density (TD), which combines both volume and speed of traffic. The traffic volume is defined as the number of vehicles passing a certain point within an established time period. The traffic volume must be combined with the average speed of the vehicles because a low vehicle count alone could indicate either low congestion or, when the road is heavily congested with slow moving traffic.

Traffic data will be collected over a defined interval (e.g. 5−15 minutes). The TD (vehicles/mile/lane) will be computed from vehicle counts and speeds as follows:

Traffic Density = ((C/P)*3600)/(S*N)

Where: C = The total vehicle count over the period.
P = Length of the measurement period in seconds.
S = Average measured vehicle speed over the period in MPH.
N = The number of lanes in operation at this tolling zone in this traffic direction.

Traffic density is correlated to LOS using the following table, which is based on data obtained from FHWA.

Traffic Table	
Level Of Service	**Traffic Density** **(Vehicles/Lane/Mile)**
A	0–11
B	>11–18
C	>18–26
D	>26–35
E	>35–45
F	>45

For example, a six-minute count of 120 vehicles traveling in an HOV lane at 55 miles per hour (MPH) would result in a traffic density of 21.8 or LOS "C" ((120/360)*3600)/55*1). This would translate into 1,200 vehicles per hour.

Traffic densities at a single VDS may be impacted by environmental or geometric conditions and, therefore, misrepresents the actual traffic condition within a segment of the Smart Lane. To address any misrepresentation, a coefficient must be determined and applied to any affected TD. Below is an example of how the weighted TD would be calculated. In this example, the North Tolling Zone may have a higher coefficient than the other tolling zones, to account for its geometric conditions (e.g. length and grade). The table of coefficients would contain one row for each Smart Lane entrance location and one column for each tolling zone. In this case there is a direct correlation between tolling zones and entrance locations.

Tolling Zone Coefficients – Southbound from Andrade Road to Mission Blvd.			
	Smart Lane Entrance Points		
	Point 1 Andrade Road	**Point 2** Washington Blvd.	**Point 3** Mission Blvd.
North Tolling Zone (Andrade Road)	1.2	1.1	1
Central Tolling Zone (Washington Blvd.)	0	1.1	1
South Tolling Zone (Mission Blvd.)	0	0	1

The TD is used in the toll rate setting function, so that the toll rate will adjust up or down based upon the change in the Smart Lane TD. The change in the TD is the current TD minus the previously calculated TD. Small Smart Lane TD deviations might result in small or no change to the toll rates. Large deviations will typically result in large changes to the toll rates.

In addition to determining the TD at each VDS location, the variation of TD along the Smart Lane due to the impacts of traffic entering and exiting the facility will be considered. This is necessary to manage the number of vehicles entering the Smart Lane at any given point and to reduce their impact on downstream congestion. This will be accomplished by assigning each VDS to a specific entry point for the calculation of the toll rate.

Toll rate increments for changes within LOS "A" and "B" will be small, but increments for LOS "C" will be higher. As the TD approaches the upper end of "C", the rates would climb high enough to discourage additional paying SOVs from entering the lane. The toll rate would become prohibitively high if LOS "C" were exceeded.

The Smart Lane TD rate changes will be determined from the following:

- The current charging rate;
- The LOS represented by the maximum TD at the downstream tolling locations;
- The largest traffic density (LTD) of the previous toll rate adjustment period; and
- The toll rate that is assigned to the change in LTD.

The system will compute the TD at each VDS downstream from each tolling location and then select the LTD.

$LTD_n = MAX(A_{n1}*TD_1,A_{n2},*TD_2,\ldots A_{nj}*TD_j)$

> Note: Where $A_{n,j}$ represent a set of definable coefficients, there is one set of coefficients for each Smart Lane entrance location; each member of the set is used to multiply the traffic density in its tolling zone in a manner that reflects the characteristics of that particular zone. The arrangement presumes that there are "n" Smart Lane entry points and "j" tolling zones in the direction of travel. MAX (. . .) represents a function that selects the largest member from a set of values.

The LTD values for each 30-second period are collected over a fixed time period (e.g. six minutes) and the average of these LTDs is the final TD for the selected period.

The system will compute a toll rate adjustment for the entry point based on the computed final TD discussed above. The new toll rate will be determined by adding the incremental toll adjustment found in the TD rate of change table to the current toll. The following table illustrates the adjustment function for TDs in LOS "C":

LOS "C" Delta Settings

Level of Service Delta Settings						
TD	Δ1	Δ2	Δ3	Δ4	Δ5	Δ6
20	0.00	0.25	0.50	0.75	1.00	1.25
21	0.00	0.25	0.50	0.75	1.00	1.25
22	0.00	0.25	0.50	0.75	1.00	1.25
23	0.00	0.25	0.50	0.75	1.00	1.25
24	0.00	0.25	0.50	0.75	1.00	1.25
25	0.00	0.25	0.50	0.75	1.00	1.25
26	0.00	0.25	0.50	0.75	1.00	1.25
27	0.00	0.25	0.50	0.75	1.00	1.25
28	0.00	0.25	0.50	0.75	1.00	1.25
29	0.00	0.25	0.50	0.75	1.00	1.25

A new LTD of 24 and an LTD from the previous period of 20 would produce a change of 4 (Δ4). Reading across the row for the new LTD of 24 to the column with the heading Δ4 would give the rate increment of $0.75. Thus, $0.75 would be added to the current rate producing the new rate. If the change in LTD is negative, the rate would be decreased.

Traffic increase patterns are not the inverse equivalent of traffic decrease patterns. Therefore, toll rates should not increase in the same manner as they decrease. To account for this difference, a minimum and maximum toll rate for each LOS will be established. As the toll rate is incrementally adjusted, these minimum and maximum toll rates will be used to ensure that the calculated rate does not change dramatically in a short period of time.

4.2.3 Using Mixed-Flow Lane Traffic Volumes to Adjust Toll Rates

Collecting optimum toll revenue to support the project financially is one of the project goals. Revenue collection can be enhanced by designing into the ETS the ability to react quickly to changes in travel time in the MF lanes and adjust the toll rate to reflect the difference in travel times in the MF lanes.

The inherent advantages of the motorist to use the Smart Lane are time savings and the elimination of frustration in having to drive in slow-moving MF lane traffic. The travel time in the Smart Lane, barring an incident in that lane, should be consistent and can be easily verified by VDS equipment in the MF lanes. The travel time in the MF lanes will be measured and the two compared. A toll rate table can then be established to reflect the value of the actual time savings for the motorists. The following is an example (not factual) of this type of table.

Smart Lane (minutes)	Mixed-flow Lanes (minutes)	Savings (minutes)	Rate ($)
20	20	0	0.50
20	25	5	0.75
20	30	10	1.50
25	40	15	2.50
25	45	20	3.50

The toll rate in the Smart Lane would be set based upon the travel time savings as illustrated above. However, LOS "C" must be maintained in the Smart Lane. Thus, the travel time savings rate would be adjusted to ensure free-flow conditions in the Smart Lane. For example, if the travel time savings rate indicates a rate of $3.50, but the TD in the Smart Lane has increased to a point of slowing down traffic to a level of service "E", the toll rate would be increased by the amount indicated in the algorithm for managing traffic in the Smart Lane, as described in the previous section. Thus, the goals of managing traffic in the Smart Lane and maximizing revenue would be accomplished.

4.3 OPERATIONAL PARAMETERS

The number of access points to and from the Smart Lane will be limited to pre-designated locations. These points will be clearly signed and striped to indicate whether it is an entrance to the Smart Lane or an exit from the Smart Lane. This approach should improve operations and safety by discouraging continuous weaving between the Smart Lane and the MF lanes. Additionally, limiting the number of access points reduces the number of tolling zones, simplifies enforcement efforts and simplifies motorist's understanding of how toll rates are assessed.

Based upon current plans, the I-680 Smart Lane operation will be 24 hours per day, seven days a week (24/7), pending an official decision by the JPA. A 24/7 operation is more easily understood by potential users since the choice to use the Smart Lane would always be consistent. At any time of day, a potential user need only decide whether or not they want to pay the current toll if they are not eligible to use the lane for free. This configuration will also permit the assessment of a zero dollar toll during specified time periods, if so decided by the JPA. It will also simplify the Smart Lane system enforcement and more easily transfer to other Smart Lane facilities in the future. Lastly, the 24/7 operation will simplify the ETS design and operation.

Tolls will be assessed using FasTrak transponders. Toll-paying vehicles will be required to have a transponder in good standing. The Smart Lane operation will not require any changes to current FasTrak operations.

Current California legislation allows the following vehicles to utilize the Smart Lane without paying a toll:

- Carpools with 2 or more passengers;
- Express buses;
- Motorcycles;
- Low emission vehicles;
- Marked paratransit vehicles; and
- Registered hybrid vehicles.

4.4 I-680 Smart Lane Geometric Configuration

The following figure is a schematic diagram that shows the proposed preliminary roadway system configuration for the I-680 Smart Lane. As noted above, the project will cover the southbound I-680 travel corridor from just south of SR 84 in the north end to just south of Calaveras Boulevard (SR 237) in the south. Figure 1 shows the project routing from SR 84 to Grimmer Boulevard and Figure 2 shows the Smart Lane conceptual layout from Grimmer Boulevard to SR 237. Based upon a preliminary assessment of access requirements, the proposed points of access and egress are depicted in this schematic.

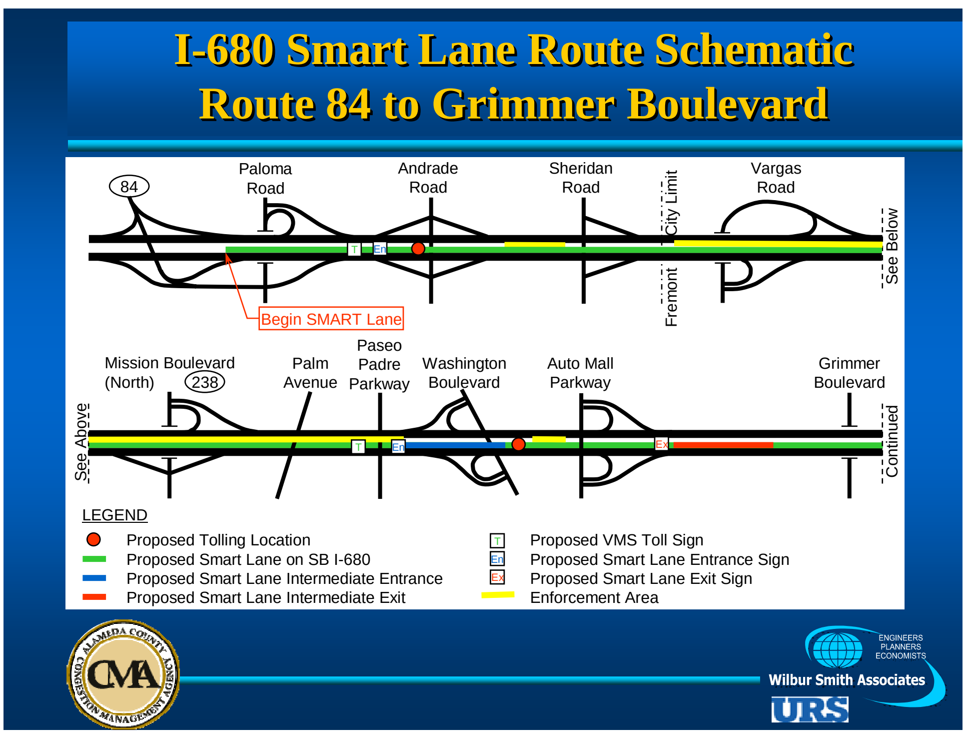

Figure 1 - I-680 Smart Lane Concept

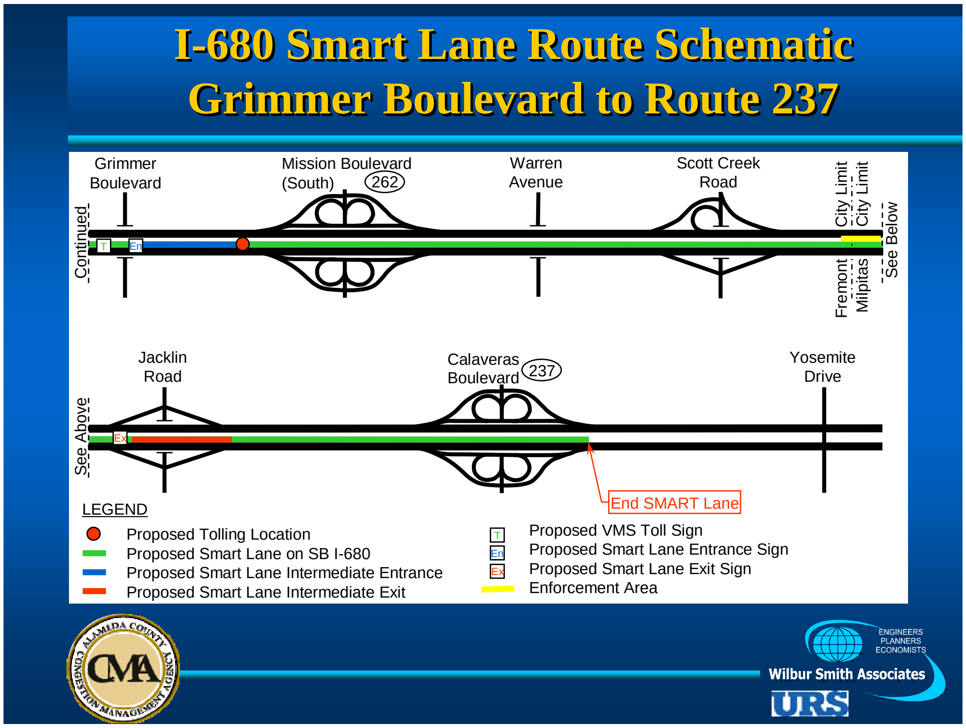

Figure 2 - I-680 Smart Lane Concept

The schematics show the selected locations for tolling zones. The tolling zone locations will be at the northern terminus just north of Andrade Road, just north of Washington Boulevard and just north of Mission Boulevard South (SR 262). The schematic also shows the preliminary location of the various signs. This includes both static signs in advance of each access point, as well as dynamic message toll-rate signs situated approximately one-half mile upstream of each entry point to the Smart Lane.

The Smart Lane system will use new JPA VDSs to continually monitor total traffic volumes and speeds in the Smart Lane and provide travel time data from the MF lanes. This data will be obtained directly from the new VDSs designed, procured and deployed by the ETS Contractor. Caltrans VDS data, which would be transmitted from the TMC, will be used only for back-up purposes in case any of the new JPA-deployed VDSs fail to provide the required data.

Enforcement areas will be constructed to assist CHP officers in Smart Lane enforcement. The yellow lines shown in Figures 1 and 2 represent where the proposed enforcement zones will be located. Each of the enforcement zones will be located on the inside shoulder and will be approximately 4.8 meters wide and at least 400 meters in length. One enforcement area may be implemented between Andrade Road and Sheridan Road and a second may be situated between Vargas Road and the Paseo Padre Parkway underpass. A third zone may be deployed immediately south of Tolling Zone #2, just north of the Auto Mall Parkway interchange, and the fourth one might be deployed north of the Jacklin Road interchange. These areas will allow CHP officers to enforce proper use of the Smart Lane in a safe manner.

Figure 3 shows a typical Smart Lane intermediate entrance/tolling zone concept. In this diagram, traffic flows from left to right. Vehicle operators in the MF lanes would first see the Smart Lane entrance advisory sign, which would have a static legend providing advance notice of an upcoming entry point to the Smart Lane. Approximately one-half mile prior to a vehicle's entering the Smart Lane, a DMS will display the current toll rate applicable for that entry point at that time. The tolling zone itself will be located just downstream from the access point.

The design of the entrance point includes a 300-meter auxiliary lane, enabling vehicles to merge into the HOV/Smart Lane safely and just prior to traversing the tolling zone. This auxiliary lane will be constructed within the existing Caltrans right-of-way (ROW) and will require design exceptions to the current construction program.

Figure 4 shows a typical Smart Lane Intermediate Exit Concept. Vehicles already in the Smart Lane will have an opportunity to exit at specific locations separated from entry points. A static sign, typically mounted on the median barrier just prior to the exit point, would advise motorists where to exit the Smart Lane in order to access downstream interchanges. Similar to the entrance/tolling zone site, a 300-meter auxiliary lane will be constructed enabling vehicles to exit the HOV/Smart Lane and to merge back into the MF lanes safely. This design can be implemented within the existing Caltrans ROW, pending approval of design exceptions.

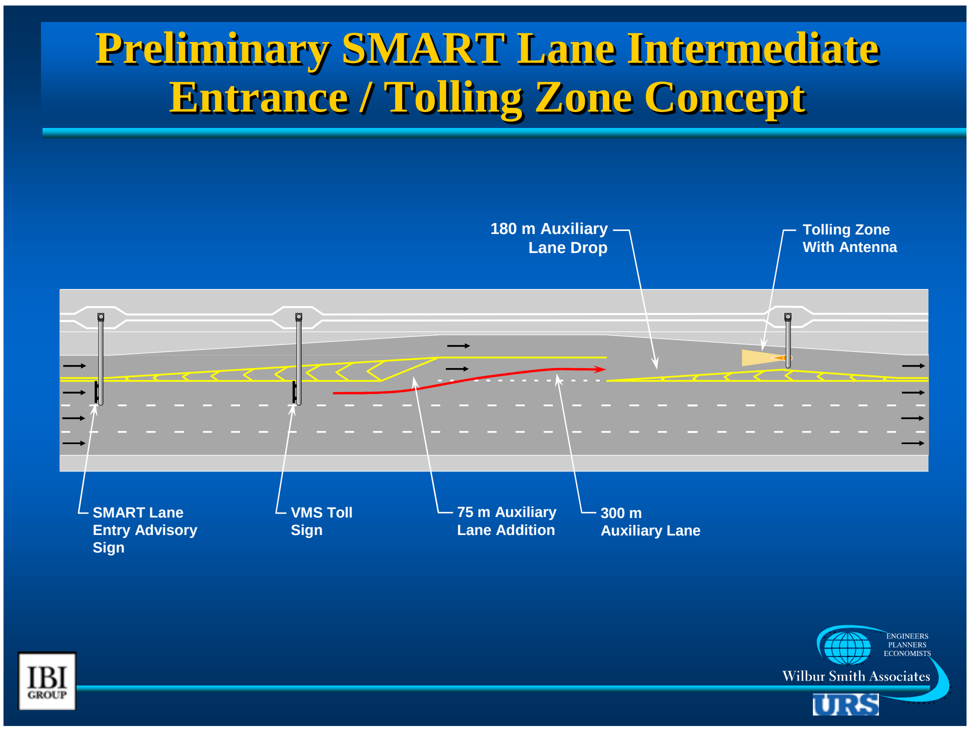

Figure 3 - Smart Lane Intermediate Entrance/Tolling Zone Concept

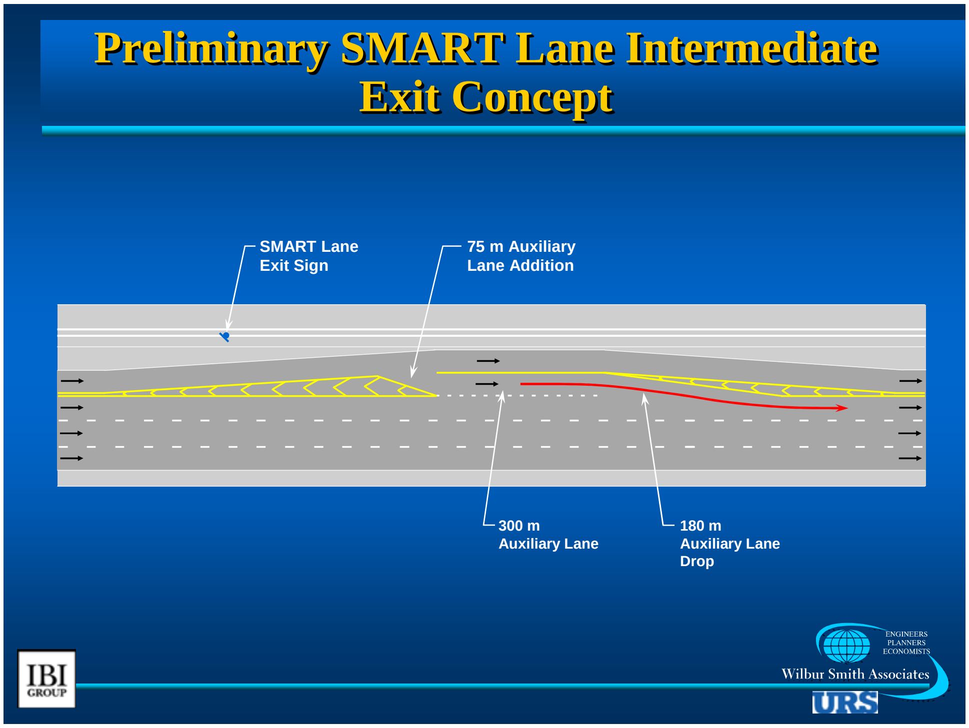

Figure 4 - Smart Lane Intermediate Exit Concept

4.5 MOTORIST'S VIEW

The motorist's view of the Smart Lane system will be straight forward. Carpool, express buses, motorcycles and other authorized vehicles will continue to travel in the HOV lane at no charge. SOV operators must have a valid FasTrak account, a properly installed transponder and pay a toll for use of the Smart Lane.

While driving in the MF lanes of I-680, motorists will view DMSs that are placed in advance of entrance points to the Smart Lane which will indicate the current toll for use of the lane. At the northern Smart Lane entry point the DMS will show two toll rates; one for travel to the first exit and the second for travel to both the second exit and the southern end of the Smart Lane. At the second entrance point, the DMS will show two toll rates; one for travel to the first exit and the second for travel to both the second exit and the southern end of the Smart Lane. At the third entrance, the DMS will show one toll rate which is the rate to travel to the second exit or to the end of the Smart Lane.

All vehicles that enter the Smart Lane will travel through the tolling zone and the ETC antennas will detect the presence of FasTrak transponders. Tolling points are placed as close as possible to the entry point (and the accompanying DMS) to ensure that the driver is charged no more than the rate that is displayed on the sign at the time of entry. The motorist will, in most cases, be charged the exact toll rate that is displayed prior to their entry into the Smart Lane. In rare cases, the motorist may be charged a lower rate depending upon whether or not the dynamic pricing algorithm is in the process of raising or lowering the toll rate at the same instance in which the motorist is traveling under the DMS. In any case, the motorist will never be charged more than the toll rate that is displayed on the DMS prior to the entrance of the Smart Lane.

A “time offset” might be established to allow for adequate travel time from the DMS to the tolling zone in the event that the toll rate has changed between the time in which the DMS displayed the toll rate and when the driver traverses the tolling zone. This “time offset” cannot exceed the toll rate change interval.

The Smart Lane SOV drivers will be alerted when a toll has been collected by an audible signal from the transponder. Motorists whose vehicles are equipped with a transponder and who want to use the Smart Lane as an HOV must properly “shield” their transponder to prevent having tolls charged to their account. Their transponder will need to be shielded by the motorist placing it into the protective mylar bag, which is provided to FasTrak customers when they join the ETC Program. FasTrak account holders are provided with complete instructions on the use of the mylar bag at the time they establish their account.

The Smart Lane SOV customers will be able to access their FasTrak account status and monitor their toll-paying activity either in person at the RCSC, via the telephone or on-line by utilizing the BATA FasTrak website.

4.6 OVERVIEW OF TECHNOLOGY CONFIGURATION

This section provides a functional overview of the Smart Lane technology configuration. Figure 5 provides an overview of the Smart Lane System Layout. The basic system would consist of the following subsystems:

- Tolling Zone Systems;
- Smart Lane Toll Processing System;
- FasTrak Account Management System;
- Incident Response/Safety System; and
- Smart Lane Enforcement System.

Tolling Zone (TZ) Systems – All of the roadside equipment, including the ETC antennas, ETC readers, controller units, indicator lights (beacons) and gantries are located within the TZs. The primary activities that occur at the TZs are the detection and identification of transponders, generation of FasTrak transactions, collection of VDS data (for those VDSs directly linked to the TZ), storage of the TZ data and transmittal of the transactions to the TDC for processing;

Smart Lane Toll Processing System – This system consists of the computers that receive the VDS data, operate the dynamic pricing module, develop the Smart Lane trips, format the trip/revenue records according to BATA requirements and transmit the trip/revenue records to the BATA RCSC for processing.

FasTrak Account Management System – The BATA RCSC will receive and process all of the Smart Lane toll trip records, provide FasTrak account maintenance for Smart Lane SOV customers, receive and process FasTrak program membership applications, distribute transponder kits to new customers, provide Smart Lane (FasTrak) customer reports and other information to the JPA and have CSRs answer FasTrak Program queries. Account management services will be performed by BATA according to a services agreement that is developed between BATA and the JPA.

Incident Response/Safety System – This subsystem will be operated by the Caltrans TMC and will include the provision to change the DMS messages to direct motorists in case incidents occur on southbound I-680 requiring utilization of the Smart Lane for purposes other than normal HOV or toll-paying SOV traffic. When an emergency situation has been cleared, the TMC operator will manually return the management of the Smart Lane back to the JPA.

Smart Lane Enforcement System – This subsystem includes CHP enforcement of the Smart Lane using several enforcement tools, including tolling zone beacons, mobile enforcement reader (MER) devices that will be mounted on CHP vehicles and hand held enforcement devices.

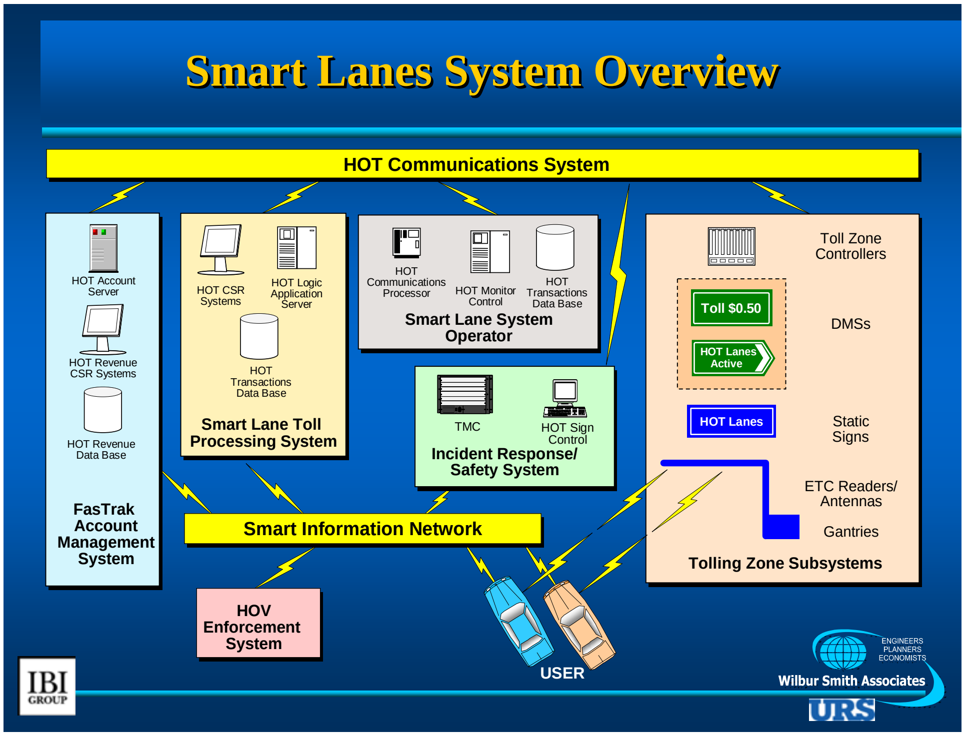

Figure 5 - Smart Lane System Overview

4.6.1 I-680 Smart Lane Data Communications Network

The ETS consists of roadside equipment for the monitoring of traffic flow, control of DMSs and the detection of transponder equipped vehicles. All of this equipment will be connected to the TDC via a communications network which handles the data transmission process. In addition, the BATA RCSC will be connected to the TDC via a communications network. Due to the importance of monitoring traffic conditions in real time and collecting traffic density and travel time information in a timely manner, a reliable, secure and highly available communications network is essential to the Smart Lane application.

Presented below are the various communication system nodes that will be required for the Smart Lane operation:

- Tolling Zone Subsystem Nodes;
- Toll Data Center Node;
- BATA Regional Customer Service Center Node;
- Caltrans Traffic Management Center Node; and
- JPA/Smart Information Network Nodes.

Presented in Figure 6 is a schematic that shows the different communication node connectivity required to support Smart Lane operations. A more detailed description of each individual node and how it fits into the overall Smart Lane communication system follows.

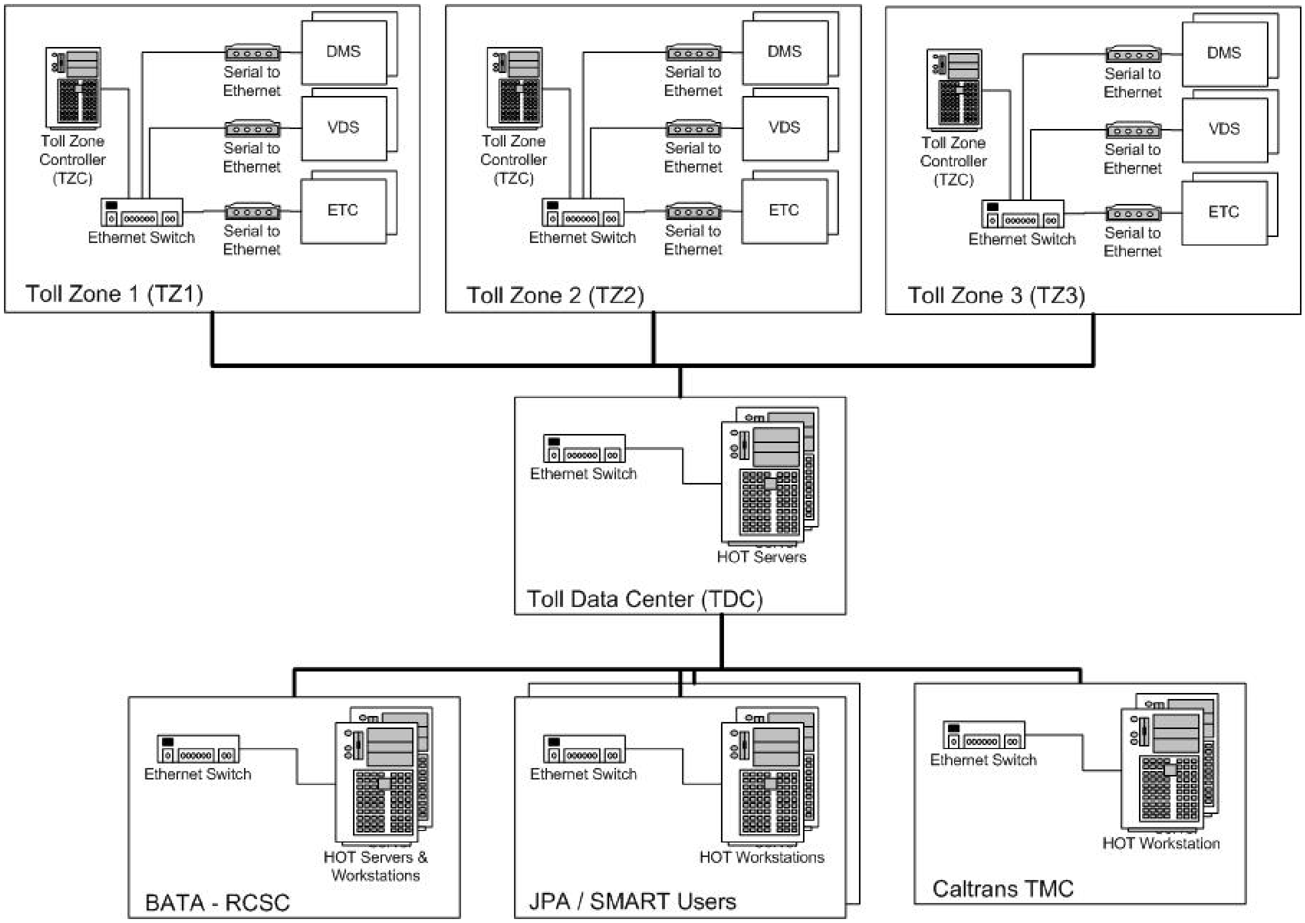

Figure 6 - Communication Node Connectivity

4.6.1.1 Tolling Zone Subsystem Nodes

The Tolling Zone subsystem nodes will manage communications to the TDC and between all equipment that is installed at the designated roadside TZs as well as other devices that are located along the corridor in the vicinity of the TZs. The local field equipment includes, as a minimum:

- Tolling Zone Controllers;
- FasTrak Readers;
- FasTrak Antennas;
- DMSs;
- VDSs that are installed nearby one of the TZs;
- FasTrak transponder detection beacons; and
- CCTV cameras.

4.6.1.2 Toll Data Center Node

Toll Data Center node will manage the following communication links:

- TDC to the Tolling Zone Controllers;
- TDC to the BATA RCSC;
- TDC to the Caltrans TMC; and
- All TDC internal communication links to support:
  1. Dynamic pricing module;
  2. Trip transaction processor;
  3. Transaction validation database;
  4. Revenue transaction/reconciliation processors;
  5. Transaction database system (replication of TDC database); and
  6. Smart Lane TDC CSR workstations.

4.6.1.3 BATA Regional Customer Service Center Node

The BATA RCSC node will manage all internal communications to:

- The FasTrak customer account database;
- BATA CSR workstations;
- Interactive voice response (IVR) system;
- Transponder management subsystem; and
- Revenue collection subsystems.

The internal design and implementation of the RCSC communication links are the responsibility of BATA. The TDC node, which will be under the responsibility of JPA, will handle 2-way communications with the RCSC.

4.6.1.4 Caltrans Traffic Management Center Node

The Caltrans TMC node will manage all internal communications for:

- Remote control/override of the Smart Lane DMSs under emergency traffic circumstances;
- Remote monitoring of Caltrans field devices; and
- Monitoring of Caltrans CCTV camera feeds, if available.

The internal design and implementation of the TMC communication links are the responsibility of Caltrans. The TDC node, which is the responsibility of JPA, will handle all required 2-way communications with the TMC. A procedure will be developed between Caltrans and the JPA to determine the decision-making process when there is an unusual event that will cause the Smart Lane, or the MF lanes, to be closed. The procedure will dictate what should be done by Caltrans and/or JPA staff when such an event occurs.

4.6.1.5 JPA/Smart Information Network Nodes

The JPA/Smart Information network nodes will communicate via a secure wide area network (WAN) which will provide pertinent information to other users, agencies and other entities, as might be required.

4.6.2 Smart Lane Communications System Requirements

Each of the network links that are identified in the communications node connectivity block diagram will be designed, at a minimum, to operate under the following system performance requirement criteria:

- Data Load - Data throughput requirements, which can be defined as the amount of data that can be passed across a communications link in a given period of time. The communications infrastructure will be capable of handling Smart Lane data records, transactions and transponder file downloads during peak periods.

- Capacity - The communications infrastructure will be capable of providing sufficient data capacity to meet the current data throughput needs, but will have sufficient capacity for the anticipated growth in the quantity of transactions and the possibility of servicing the northbound lanes of the I-680 Smart Lane Project.

- System Availability - Availability is defined as the percentage of network or system uptime versus total time. Typical values for high availability systems are 99.99% up to 99.999%. This corresponds to a total unscheduled downtime of 52 minutes per year and 5.2 minutes per year, respectively.

- Reliability - Acceptable values of mean time between failure (MTBF) of all communication equipment and each network link will be determined during the toll system design phase of the Smart Lane Project.

- Security - The communications infrastructure will be protected against physical damage, destruction, theft or replacement of hardware. Data security will be ensured through the use of secure communication protocols.

- Flexibility and Extensibility - The communications infrastructure design will ensure that future communication network enhancements can be easily and quickly implemented.

- Maintainability - Ease of maintenance is important for the Smart Lane project. The ability to easily configure the hardware and use plug-and-play replacement of components in the field is an important consideration.

- Interoperability - The ability to use different vendor equipment in the same network is important in order to maintain competitive pricing and for future proofing of the deployed networks. Standardization of the communication protocols would ensure interoperability.

4.6.3 Primary Nodes Physical Location

The Smart Lane Project presents a number of geographical and technological challenges due to the physical distance, terrain, and lack of existing network infrastructure in the vicinity of I-680. The following table provides the physical address of the various communication system nodes or, in the case of the three TZs, a selected address on a frontage street adjacent to the southbound travel lane at the planned location of the TZs.

Node Locations	Address
North Tolling Zone	6901 Mission Rd. Sunol, CA 94586
Central Tolling Zone	1901 Jackson Ct. Fremont, CA 94539
South Tolling Zone	45958 Research Ave. Fremont, CA 94539
Caltrans District 4	111 Grand Ave. Oakland, CA 94623
Bay Area Toll Authority RCSC	475 The Embarcadero San Francisco, CA 94111
Toll Data Center (JPA)	1333 Broadway, Suite 220 Oakland, CA 94612

Figure 7 - Facility Communication Node Addresses

Presented in Figure 8 are the geographical locations of the different Smart Lane Program facilities.

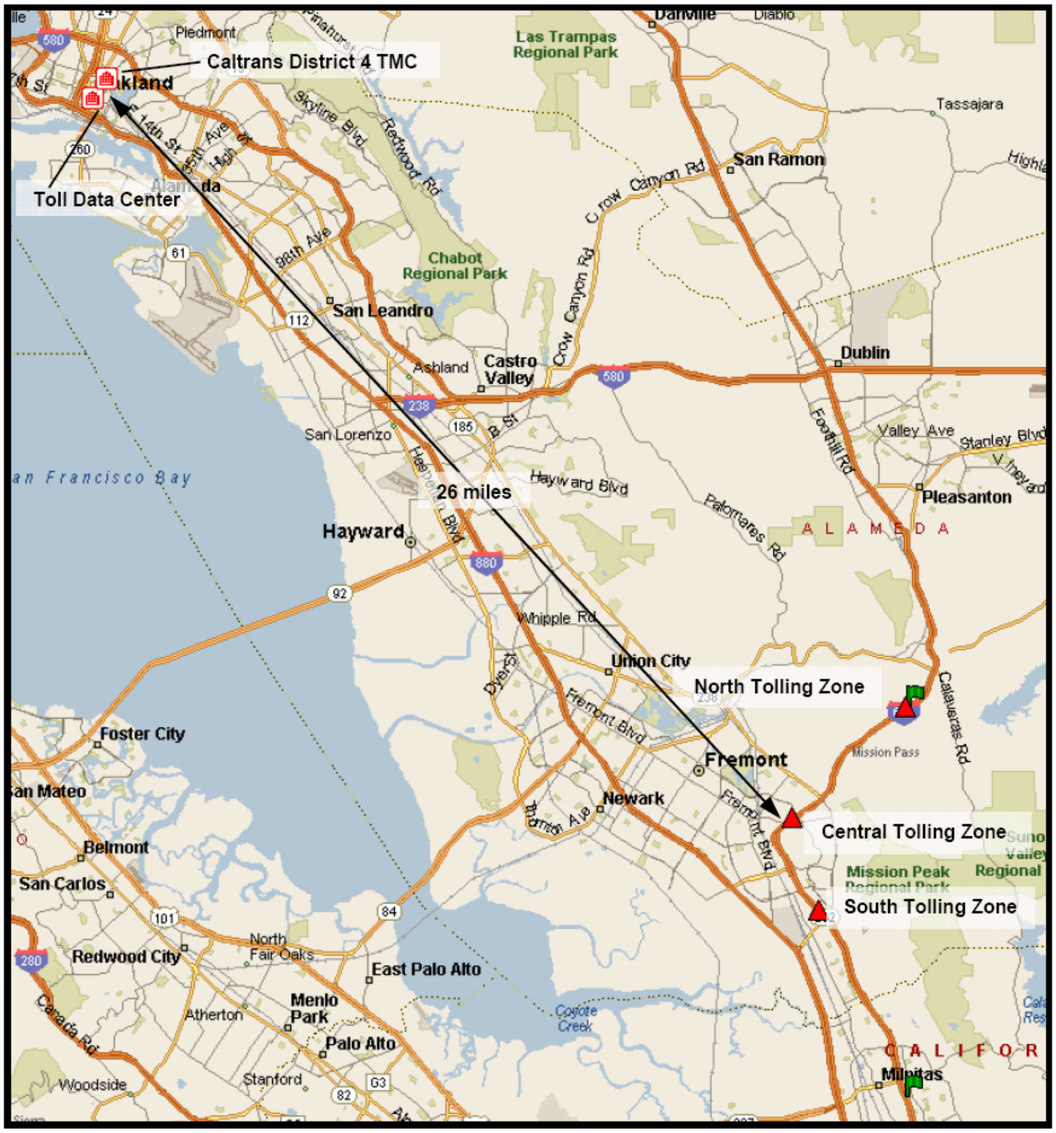

Figure 8 - Facility Locations

4.6.4 Communications Network Topology

The high level of network reliability necessary to maintain the real time monitoring of traffic flow in the Smart Lane will be achieved by implementing a hybrid of the ring and star network configurations. Figure 9 shows each of the TZs with a dedicated primary communication path to the TDC using leased communications.

In addition to this primary path, the network architecture will include secondary or redundant communication paths between the TZs. These paths will provide a failover or redundant route for communications back to the TDC. Since these paths are not a primary communications path under normal operating conditions, as would be the case in a traditional ring architecture, these paths can be implemented using a more cost-effective technology, such as wireless, or possibly a lower data rate point to point leased line connection.

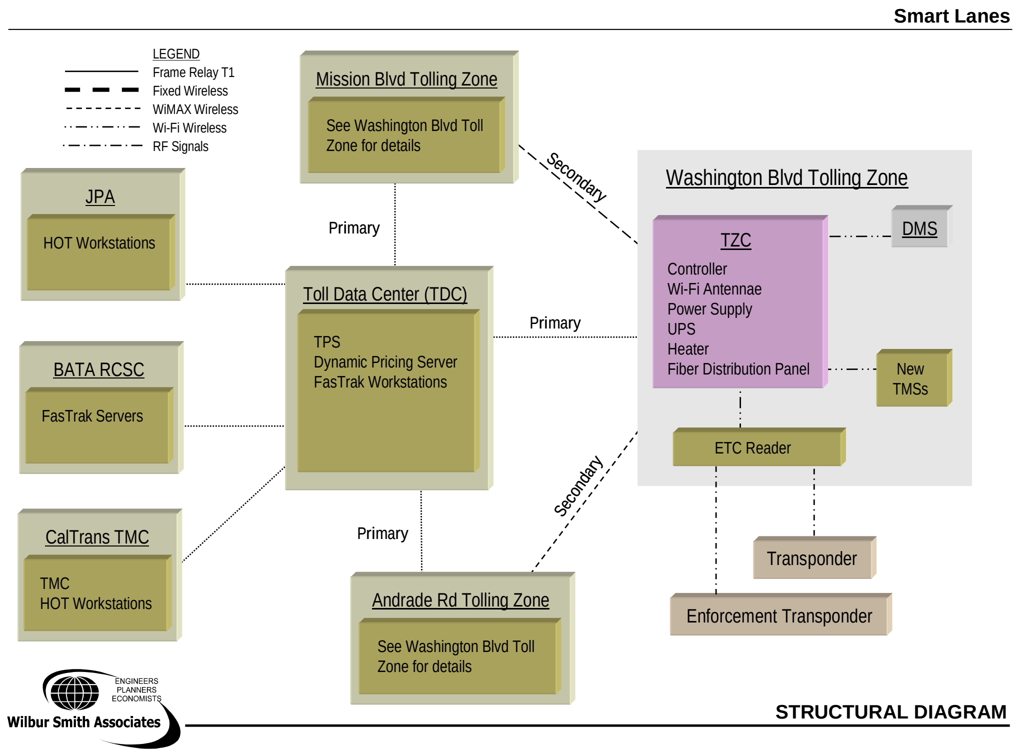

Figure 9 - Structural Communications Diagram of I-680 System

4.7 SMART LANE AGENCY ROLES

The Smart Lane system will require a successful collaboration between several entities that will support the complete operation of the Smart Lane. This section presents a logical mapping (Figure 10) of the various subsystems and explains the various agency roles in operating them. These agencies include the JPA (including Smart Lane operations), BATA, Caltrans, and the CHP.

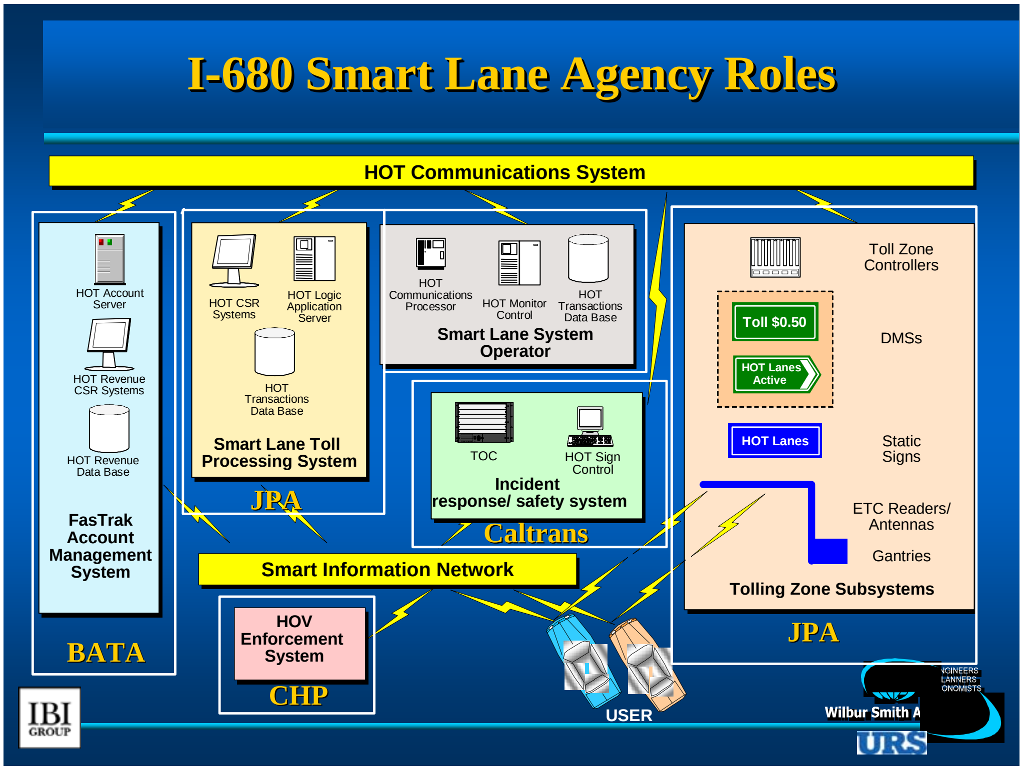

Figure 10 - Smart Lane Agency Roles

As depicted in this figure, each of the above identified agencies will be responsible for the operation of the functional subsystem in which they are associated.

The JPA, as the owner of the Smart Lane infrastructure, will be responsible for the following:

- The Smart Lane toll transaction and trip generation processing, which would be located at the TDC, tolling zone device control and monitoring, TDC operations and maintenance;
- Operation, monitoring, maintenance and technical support of the entire ETS, including the ETC readers, antennas, DMSs, tolling zone controllers, VDSs, CCTV equipment, the enforcement equipment that the CHP will utilize, and all equipment and components related to the Smart Lane communications system, which includes the links to BATA, Caltrans and CHP;
- The dynamic pricing and toll rate management process;
- Smart Lane CSR functions and monitoring;

- Smart Lane financial reconciliation process with BATA;
- Providing Smart Lane System reporting;
- Monitoring the Smart Lane System Operator (if the JPA chooses to contract out the Smart Lane operations);
- Perform lane and/or shoulder closures with Caltrans in order to properly maintain and support the Smart Lane equipment;
- Maintenance of the Smart Lane static signs and the highway lighting systems that are provided at the ingress and egress points;
- Conduct Smart Lane specific marketing; and
- Evaluation of the Smart Lane operation within 3 years of system opening.

BATA will be responsible for the following:

- Full RCSC processing, including FasTrak account management, customer service interface to the public, Smart Lane trip record processing, and revenue management functions;
- Handle management of FasTrak accounts, transponder inventory and tracking, transponder fulfillment and revenue management;
- Operate, support and maintain FasTrak back office operations; and
- Provide FasTrak revenue and account information to the JPA.

Caltrans will be responsible for the following:

- Safe operation of I-680;
- Incident response management within the Southbound I-680 Sunol Corridor, including the Smart Lane;
- Responsible for the Smart Lane DMS messages, in coordination with JPA staff, if an emergency traffic situation arises which warrants an override of the ETS operation;
- Operation of a traffic monitoring system for the I-680 corridor; and
- Roadway maintenance.

The CHP will be responsible for the following:

- Smart Lane enforcement operation; and
- Receive FasTrak account related data via some type of JPA provided vehicle mounted hand-held device. Data will be transmitted from the TDC.

4.8 TOLL SYSTEM DESIGN CONSIDERATIONS AND REQUIREMENTS

This section presents the Smart Lane ETS concept, including the vehicle, roadway, central account management and customer interface points. A more detailed description of the major subsystems follows. The ETS and Smart Lane equipment and software will be designed to be upwards compatible in order to take advantage of the most recent technological advances at the time in which the new tolling system is to be deployed. Figure 11 provides a logical overview of the Smart Lane components and operations.

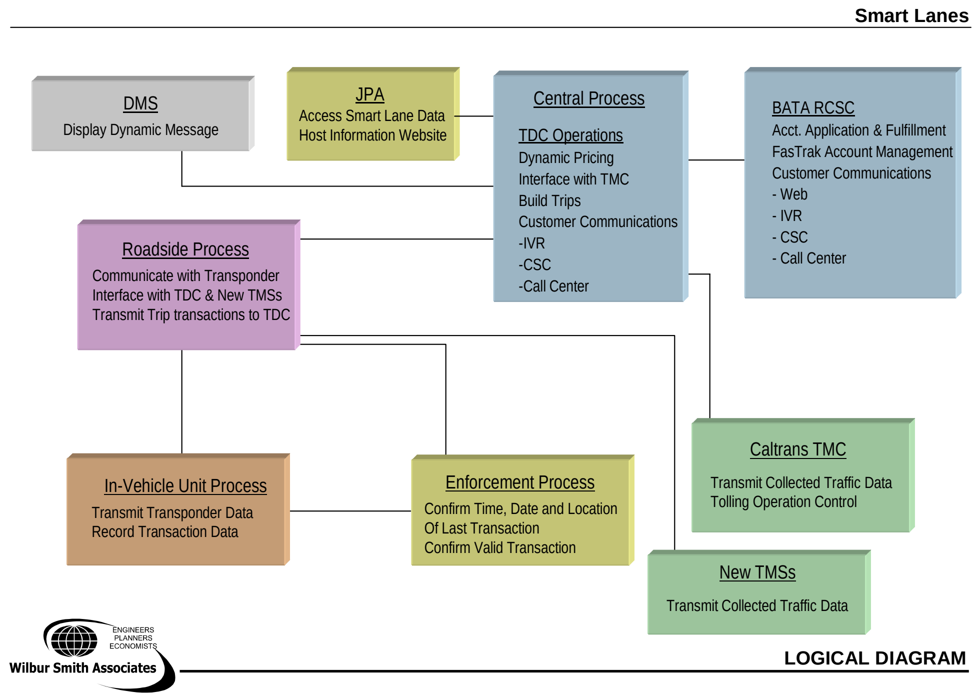

Figure 11 - Smart Lanes Logical Diagram

The ETS consists of two major functional blocks; the roadway components and the central processing components. The Smart Lane will also include various enforcement tools. The Smart Lane ETS is designed to allow the dynamic management of SOV traffic in the Smart Lane. This is accomplished through near real-time monitoring of traffic flow on the Smart Lane and in the MF lanes to establish appropriate toll rates in order to either encourage or discourage SOV use of the HOT lane.

The roadside subsystem consists of several major components, including transponders, roadside tolling zones, FasTrak transponder detection beacons, tolling zone controllers, DMS and VDSs.

The DMSs will be integrated with the TZCs through a fiber optic communication link. The TZCs will also be interconnected, through the TDC, with the Caltrans TMC in order to provide ongoing traffic data and to receive TMC operator override commands for lane operational status. The new VDSs will provide the ETS with continually updated traffic volume and speed data on the Smart Lane and travel time information from the MF lanes in order to determine when periodic dynamic toll rate adjustments are required.

4.8.1 Title-21 Compliance

Title 21 has been established to ensure that any ETC system that is installed in the State of California will be interoperable with all current and any future ETC systems in the state. Title 21, as it pertains to the toll industry, is detailed in Chapter 16 of the California Code of Regulations entitled "Compatibility Specifications for Automatic Vehicle Identification (AVI) Equipment". This section requires that all AVI (also referred to as ETC) equipment installed in the state of California be compatible with the standards and regulations set forth in the code of regulations. This compatibility specification has been developed around two principal front-end components: a reader and a transponder. The specification defines specific equipment and communication specifications for both the reader and transponder as well as defines the messages and message format that should be communicated between the two devices.

The I-680 Smart Lane ETS will meet all Title-21 requirements of the toll system operational requirement standards that are in place in the Bay Area at deployment of the Smart Lane.

4.8.2 Transponders

The transponders are small electronic transceiver devices that are mounted on the inside of the vehicle's windshield typically behind the rearview mirror. In some cases it is necessary to utilize license plate mounted transponders for those vehicles with metallic windshields which cause radio frequency (RF) shielding inside the vehicle. They enable the unique identification and tolling of SOV motorists electronically using RF technology.

The transponder is battery powered and user installable. The transponder communicates with a roadside antenna, which is installed at the tolling zones. Each transponder contains a unique serial number that identifies it to the ETS. This allows it to be associated to a driver's FasTrak account for paying the applicable toll.

The transponders will be identical to the currently used FasTrak tags which comply with all Title-21 requirements and utilize a protocol that is applicable for high-speed tolling.

The FasTrak transponder communicates with the driver via audible tones. This allows the system to signal the driver that the transponder is working correctly. Under normal operations, a beep will be sounded each time an SOV's transponder is detected as the vehicle traverses the tolling zone. If the SOV driver does not receive this audible tone then they will need to contact the RCSC to check their account status and/or have their transponder inspected. If a FasTrak account holder is traveling on the Smart Lane as a carpool, in order to not have their transponder read, they need to insert it into a protective mylar bag.

4.8.3 Dynamic Message Signs (DMSs)

The Smart Lane will contain three (3) tolling zones. Each TZ will be preceded by at least one DMS.

It is anticipated that the Smart Lane DMSs will be LED-based message signs that are capable of displaying alphanumeric characters. The DMSs are a part of a composite sign comprised of a traditional static sign and the dynamic sign portion. The static portion will display general information about the Smart Lane and provide context for the dynamic message portion.

4.8.4 Roadside Tolling Zone Sites

The TZs will be equipped with ETC readers, ETC antennas, VDSs, transponder read indicator lights and a TZC unit. The antennas, which will be mounted on a gantry to about the centerline of the Smart Lane, will communicate with the transponders that are mounted in the SOV as it travels through the TZ. The TZ site will consist of one antenna and a roadside electrical cabinet that houses the ETC reader, a fiber-optic multiplexer and a power supply with battery backup.

Environmentally hardened equipment that is designed to withstand the weather conditions typically experienced in the Bay Area is to be located within the cabinets. Each cabinet is provided with electrical power and a communication source.

The ETC reader is connected to the antenna, which is mounted over the Smart Lane as described above. The reader is a Title 21 compliant transmitter/receiver unit capable of reading all transponders in the Smart Lane. The multiplexer allows the reader to communicate to the TZC. The power supply ensures that clean and reliable power is provided to the reader and multiplexer even in the event of a power outage of several hours.

All the components of the roadside system will be tied together via the tolling zone communications network.

4.8.5 Closed Circuit Television Cameras

CCTV cameras will be installed on a pole at each of the three TZ sites for the primary purpose of monitoring the TZ equipment and operations. The CCTV cameras will be standard freeway traffic monitoring cameras and will provide security at each TZ and will allow observation of any problems that might occur at these locations, anomalies in traffic conditions and, possibly, DMS messages if they are installed within CCTV viewing range.

The CCTV system will be configured to allow pan/tilt/zoom capabilities and be designed for use by Caltrans staff to monitor traffic, accidents and other conditions along the corridor. The JPA will hold final control of the CCTV system's availability and use.

4.8.6 Tolling Zone Controller

The TZC is the primary roadside device (computer) that collects and stores transaction data and manages the communications between the readers, antennas, DMSs, TDC subsystem and the TMC operator application (through the TDC). The TZC is typically two independent computers; a primary unit that handles normal operations and a secondary unit that monitors the primary unit's status and is capable of taking over control in the event of a malfunction with the primary unit. This redundant design ensures that the tolling operation can continue despite a failure within the TZC subsystem.

4.8.7 Vehicle Detection Stations

There will be approximately 12 VDS locations placed along the Smart Lane. The VDS will consist of equipment located in or along southbound I-680 to detect vehicles and traffic speeds in the Smart Lane and collect travel time data from the MF lanes.

4.8.8 Transaction Processor

As toll transactions are received from the TZCs, they will be provided to the TDC-based Transaction Processor Subsystem (TPS). The TPS is responsible for the merging of individual transaction records into trip records, or what is typically referred to as trip formation or construction. The TPS will implement pre-defined business rules based upon reasonable travel times to determine whether or not the transaction records from the tolling zones should be formed into single or multiple trips. This subsystem will be located at the TDC and will be owned and operated by the JPA.

4.8.9 JPA Application Graphical User Interface (GUI) with the Smart Lane

The JPA will be provided with a Smart Lane application GUI that will offer predetermined options from which the Smart Lane operator can select. The application will allow the JPA to change the operational mode of the Smart Lane. There are four possible Smart Lane modes:

1. Closed to all traffic;
2. Open to HOV traffic only ($0.00 rate for HOV and all other vehicles are considered violators);

3. Open to HOV and SOV (with FasTrak transponders) traffic only (rate based on dynamic pricing); and
4. Open to all traffic ($0.00 rate for all, no violators).

All tolling mode overrides will be recorded by the TPS to ensure that the correct toll rates are utilized under each of the above identified operating modes. The ETS will also be capable of implementing prescribed operational procedures to revert the system back to normal tolling operation following these overrides.

TMC operator override of the Smart Lane will be performed under emergency conditions only and will include JPA staff input, if possible. The TMC operators will be able to change the operational mode of the Smart Lane but will not be able to change the toll rates that are set as part of the dynamic pricing process. Once an incident is concluded, the TMC operator will have to manually switch back to tolling mode.

4.8.10 Smart Lane Enforcement

The CHP will be responsible for enforcing the requirement that SOVs pay the appropriate toll through the use of a valid FasTrak transponder. Violators will be cited for violating the HOV 2+ occupant policy. The enforcement task requires the officer to determine visually the number of occupants within the vehicle. If there is only one occupant, the CHP Officer would then need to determine whether that vehicle operator is using a valid transponder. To simplify the enforcement task, the JPA will provide the CHP with three enforcement tools; FasTrak transponder detection beacons, MERs and hand held enforcement devices. These tools will allow the CHP to determine whether a transponder linked to a FasTrak account that is in good standing is read as it traverses a tolling zone.

4.8.10.1 FasTrak Transponder Detection Beacons

Transponder detection light beacons will be installed in close proximity to the tolling zone gantries. The beacons will be located in a position to allow CHP officers to clearly see them from their enforcement zone locations and will illuminate when a FasTrak transponder linked to a FasTrak account that is in good standing is read as it traverses the tolling zone. Conversely, if a vehicle drives through the tolling zone and a valid transponder read does not occur, the beacon will not illuminate, which will signify to the CHP officer that this vehicle must be checked to see if it is a valid, non-paying HOV vehicle.

4.8.10.2 Hand Held Enforcement Units

Hand held enforcement units will also be provided to CHP officers that are conducting Smart Lane enforcement in vehicles that are not equipped with a MER, including motorcycles. This unit will operate as a wireless device, and therefore it can be transferred from vehicle to vehicle. This unit will be designed to read the account number from FasTrak transponders when they are swiped across the read zone of the unit. Once the transponder number is read, the software program that is resident on the hand held device will determine which account is associated with it. Once the FasTrak account number is identified, that number will be compared to the account status file, which is also resident in active memory in the unit, to determine whether or not the account is in good standing.

New versions of the FasTrak tag status file will be automatically downloaded from the Toll Data Center to the hand held device each day at approximately 2:00 a.m. It is envisioned that an incremental tag status file will be transmitted each day to the hand held device, not the entire valid FasTrak account list. This information will allow the CHP officer to issue a violation citation to the vehicle operator if the transponder (or account) is not valid and there is only one person in the vehicle.

4.8.10.3 Mobile Enforcement Readers

The future Smart Lane will be delineated with striping to separate it from the MF lanes. Therefore, CHP enforcement officers will need to remain mobile while patrolling for Smart Lane violators. This will require that the enforcement tools provided to the CHP function well while moving.

A Mobile Enforcement Reader (MER) will permit Smart Lane enforcement activities by CHP Officers while traveling at highway speeds. The MER will be mounted on or within the CHP patrol vehicles and consists of an ETC reader, control/display unit and an antenna. The ETC reader is a transceiver that operates at 915 MHz frequency. The control/display unit is designed to be used while safely driving the patrol car and is mounted in the front seat of the vehicle within easy reach of the officer. A directional antenna will be mounted on the roof, or back trunk lid, of the patrol vehicle, pointing towards the left side of the vehicle. This would allow the MER to detect whether a vehicle driving alongside the enforcement vehicle is equipped with a FasTrak transponder. The MER subsystem will then compare the just identified transponder number to the tag status file list that is resident in the reader to confirm whether or not the transponder is in good standing.

Figure 12 depicts a typical scenario in which a CHP vehicle is checking to see whether the vehicle traveling in the Smart Lane is equipped with a FasTrak transponder that is in good standing.

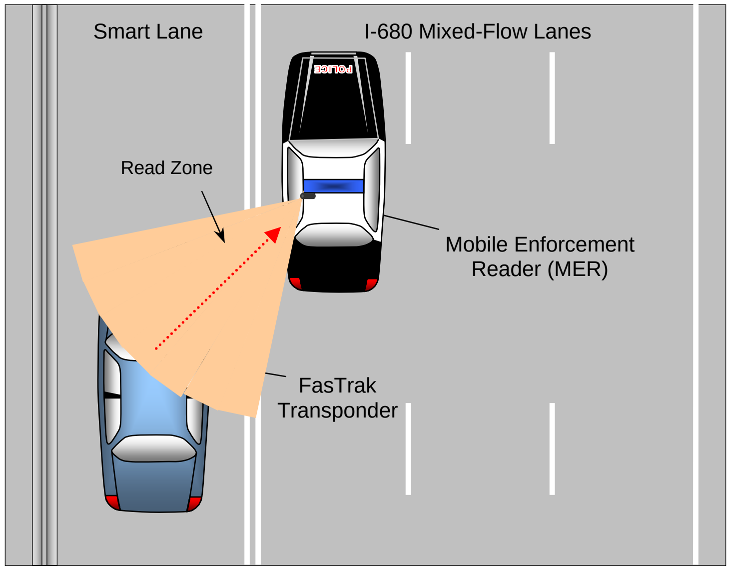

Figure 12 - Mobile Enforcement Reader Diagram

4.8.11 Smart Lane ETS Equipment Maintenance

Maintenance of all components of the tolling system deployed to support the operation of the Smart Lane will be the responsibility of the JPA. The electronic tolling equipment that is required for the operation of the Smart Lane will require periodic remedial and ongoing preventive maintenance.

Overhead DMSs and overhead VDS equipment installed in the median will be accessed through either a shoulder closure or closure of the Smart Lane during nights and low traffic demand periods. The inside northbound shoulders adjacent to the proposed median tolling equipment are 4.2 meters or greater in width at each of the three tolling zone locations. The overhead signs will be equipped with catwalks to enable maintenance to take place over live traffic, which will enable them to be accessed for maintenance without having to close the lane.

Tolling equipment that is located on the outside shoulders will be placed next to existing and proposed Caltrans equipment.

In the event that shoulder and/or lane closures are necessary to maintain the ETS equipment, the JPA will be responsible for such lane closures.

4.9 Central Account Management System

4.9.1 Regional Customer Service Center (RCSC)

The RCSC, which will be provided and operated by BATA, will have the following purposes:

- Perform all of the required FasTrak account management functions;

- Perform all of the required RCSC functions, including the Call Center, front desk for walk-in customers and processing (of new applications, reports, etc.);
- Interface to the TDC to allow JPA to send Smart Lane trips for posting to FasTrak accounts and for receipt of toll revenue from BATA; and
- Interface to the TDC for the transfer of Smart Lane customer inquiry calls.

4.9.1.1 Hours of Operation

The BATA RCSC maintains regular business hours. The BATA FasTrak account management and information website and IVR system will be available on a 24-7 basis.

4.9.1.2 RCSC Front Desk

The RCSC front desk allows customers to conduct a full complement of FasTrak account transactions. They will be able to make payments, add or exchange transponders, open accounts, close accounts, update other account information, etc. A drop-box is also available for walk-in customers who choose not to wait for personal assistance. The RCSC front desk is staffed during regular business hours.

4.9.1.3 Telephone System and Call Center

The BATA telephone system will process incoming customer calls. It includes an automated IVR system that routes calls via menu selections. The system enables customers to review their account balances, payments and toll usage at any time, 24 hours a day, 7 days a week. The system also provides messages containing general information. During hours of operation, callers have the option to transfer to a CSR.

BATA CSRs are trained in efficient account management, problem solving and customer relationship management. All customer calls pertaining to the FasTrak program will be fielded by BATA RCSC customer service staff. All FasTrak program questions will be answered by the BATA CSRs and any Smart Lane operations related questions will be transferred to the TDC so they can be handled by the JPA CSRs.

4.9.1.4 Website Access

BATA hosts a website that presents information about the FasTrak program and provides access to FasTrak patrons that will allow them to check their accounts, pending payments, recent transactions, previous statements, ask questions about the program, etc. The website will also provide information about all of the Bay Area toll facilities and allow prospective FasTrak members to sign up on-line.

The JPA will also host their own website that will present information about the I-680 Smart Lane project, describe the way that toll rates are assessed to SOVs, hours of operation, enforcement procedures, etc. The JPA site will also include a link that will automatically switch to the BATA website if customers have more specific FasTrak operational questions, want to check their account, wish to join the program, etc.

4.9.1.5 Mailroom

The BATA mailroom will be capable of printing, storing, enveloping and posting all customer related correspondence (statements, welcome kits, transponder fulfillment, etc.). The RCSC mailroom will also have the capability of opening and distributing all incoming mail for back-office processing.

4.9.2 FasTrak Account Management

Each customer account is associated with a number of basic attributes such as name, address, telephone number, e-mail address, credit card information, transponders and vehicles. This account management is currently in use by BATA.

The RCSC system allows for each account to be associated with an unlimited number of those related attributes. Changes to any of those attributes are automatically logged and the history of changes is available for viewing by the customer on the website or by a CSR using the RCSC application.

4.9.2.1 Account Management Business Rules

The Business Rules for Smart Lane customer account management will be identical to the other FasTrak customers handled by BATA.

4.9.2.2 Account Type

The RCSC will support different types of accounts, including:

- Smart Lane Personal Accounts; and
- Smart Lane Commercial Accounts.

A non-revenue type account is considered an attribute of each of these basic account types. Other types of accounts could subsequently be added pursuant to agreement of BATA (e.g., Airport parking, Airport access, etc.). All revenue-based account types will be pre-paid.

4.9.2.3 FasTrak Account Opening

The RCSC system supports the functionality for application submission by walk-up, website, mail, e-mail, phone or fax and for payment by cash, check or credit card. Potential new customers may make account inquiries at the RCSC, online or via the IVR system.

The deposit amount for the account opening is a configurable feature of the system depending upon the business rules that are established for the Smart Lane operation and are consistent with BATA guidelines. The amount can vary depending upon the method of payment, the number of transponders issued, account type, etc.

New FasTrak customers will be issued a transponder on the spot if they apply at the RCSC front counter. Otherwise, the transponder will be mailed to the new customer. In addition to the transponder, new Smart Lane customers will receive a welcome kit that will include, at a minimum:

- Description of the I-680 Smart Lane system and operation;
- Welcome letter (including the customer personal identification number (PIN) code to access the BATA website and IVR);
- Guidebook and frequently asked questions (FAQs);
- Transponder mounting instructions;
- Protective mylar bag; and
- Velcro strips (or other transponder mounting devices).

4.9.2.4 Account Replenishment

Accounts may be established to be replenished either automatically via credit card, debit card or manually by cash, check, or one-time credit or debit card. The replenishment amount will depend upon the business rules that are set for BATA FasTrak operations.

Automatic replenishment is performed as soon as the account balance drops below the specified threshold. Accounts configured for manual replenishment will automatically receive notification (by e-mail or mail) when the account balance reaches a specified threshold. The customer will be required to call-in, mail or bring payment equivalent to the replenishment amount in order to restore their FasTrak account to good standing.

4.9.2.5 Account Monitoring

The RCSC and the TPS will provide the ability to monitor and identify unusual and undesirable activity (e.g., negative balance or frequent replenishment). System processes will include the ability to generate notices, assess penalty fees, offer incentive programs and other remedial actions.

The most frequent situations are expected to be:

- Investigate negative and inactive accounts with the intent to collect and close;
- Establish a process for converting a negative customer account into an accounts receivable for collection purposes and write-off, as needed; and
- Proposing customized account types or plans to the customer.

4.9.2.6 Account Modifications/Updates

The Smart Lane customer will have real-time access to their account for updates and modifications either through the BATA website, IVR or the Call Center with a live CSR. The following information will be available:

- Personal information (including personal and billing addresses, phone numbers, e-mail, preferred contact method and time, etc.);
- Account type and plan (limited to CSR);
- Payment method modifications (switch to automatic replenishment, credit card update, etc.);
- Replenishment amount and threshold within set business rules;
- Transponder management (issuing new transponder, replacing non-working transponder, reporting a stolen transponder, returning a transponder, etc.);
- Vehicle information (including make, model, color, year, license plate);
- Customer password modification or reminder; and
- Any other comment about the account (complaint, etc.).

All changes to account attributes are logged to the RCSC database. The history of changes is available for viewing via online screens.

4.9.2.7 Account Suspension

The RCSC provides functionality for automatic deactivation and reactivation of all transponders associated with that account if the account is suspended and subsequently reactivated. The system automatically generates notices to customers in low or negative balance conditions. If the account balance becomes negative, all future transactions can be routed to Collection (depending upon the specific business rules).

As soon as the customer replenishes the account balance, the account and associated transponders return to an active/valid state.

4.9.2.8 Account Closure

Accounts may be permanently closed when:

- The customer requests it;
- The account balance remains negative for a predetermined period of time;
- The account has no activity for a predetermined period of time; or
- A transponder is used in an unauthorized manner.

The customer will either be issued a refund if the account has a positive balance or automatic collection activities will be initiated for customers with a final negative balance.

4.9.2.9 Access to Customer Data and History

The BATA and TDC CSRs will have online access to all relevant customer information, including account number, address, payment details and most recent transactions. Additionally, they can access the customer history and perform searches either in the transactions or the notes history, using different criteria including date period or type of event, or they can perform a text search on selected customer account attributes or information types.

4.9.2.10 Customer Statements

The RCSC will generate standard FasTrak customer statements on a monthly or quarterly basis for mailing to customers. These statements are produced as electronic files that can be submitted to an external statement printing and distribution facility or printed and mailed locally. Statements can also be generated electronically in hypertext markup language (HTML), portable document format (PDF) or Word format by a BATA CSR who can then fax or e-mail the statement to the customer upon request.

Upon request, the BATA or TDC CSR can view the actual statement that the customer received. This is an important feature in cases where the customer is seeking an explanation regarding certain fees or disputing specific transactions.

4.9.2.11 Customer Notices

The RCSC will have the capability to automatically manage customer notices. The customer notices will depend upon the business rules but the usual customer notices include, but are not limited to:

- Change in replenishment method;
- Change in replenishment amount and threshold;
- Denial of replenishment due to non-sufficient funds for a check;
- Credit card declined (a card on account no longer valid);
- Replenishment required (for manual replenishment accounts);
- Pending credit card expiration;
- Transponder return required;
- Negative account balance warning;
- Account suspension or revocation; and
- Account closure.

4.9.2.12 JPA and RCSC Customer Web Sites

The JPA Smart Lane website will provide general information about the project for general public access, including:

- Description of the project and how it operates;

- Contact information;
- Maps, location and opening hours of the BATA RCSC;
- Links to traffic condition and live web cams;
- Frequently Asked Questions (FAQs);
- General announcements;
- A web link that brings the person directly to the BATA home page; and
- Other to be determined links.

The BATA RCSC website will provide potential and existing customers with online capabilities for the following:

- Application for new account;
- Review of the previous statements;
- Account balance and transaction history;
- Account replenishment via credit or debit card;
- Customer information modification (address, telephone number, change of payment method, change account type, etc.);
- Credit card information modification (change of credit card details, etc.);
- Vehicle information modifications (add or remove vehicle from the account, etc.);
- Apply for additional transponders; and
- Report lost/stolen/found transponder.

Access to all account management functionality will require a secure log in, using the patron's account number and confidential password (or PIN). Access to this section of the website will require a secure connection to protect and encrypt data transmissions to and from the user's browser.

4.9.3 Interactive Voice Response (IVR) System

The BATA telephone system will have an IVR module that will be connected to the Customer Account Database (CAD). The IVR module will provide the Smart Lane customer with different options on a 24/7 basis, even when the RCSC is closed:

- Receive information on the RCSC location and opening hours;
- Open a new account;
- Order a new transponder for an existing account;
- Obtain the account status and balance; and
- Enter credit/debit card payment information.

4.9.4 Revenue Management

4.9.4.1 Automatic Smart Lane Trip Charges

Under normal operations, all of the Smart Lane trips, including transaction level detail, are automatically posted to the designated account after trip formation at the TPS. Transactions are sent electronically from the TZs to the TPS. The TPS combines transaction records to form trips and determine the appropriate toll charge, which will be inserted into the transaction that is sent to the BATA RCSC for account management purposes and as a basis for toll revenue receipt from BATA.

4.9.4.2 Payment Processing

The BATA RCSC payment processing includes:

- Account opening pre-paid tolls;
- Account opening transponder deposits;
- Account pre-paid toll replenishments;
  - Automatic with credit/debit card.
  - Manual accept cash, check, credit card or debit card.
- Monthly account maintenance fee;
- Monthly transponder fee (if applicable);
- Other specific fees (as detailed in the business rules);
- Account credits/debits;
  - Adjustments.
  - Refunds.
  - Non Sufficient Funds (NSF).
  - Write-off.

4.9.4.3 Credit Card Payments

The RSCS will manage the processing of credit card payments for account openings and replenishment (one-time or automatic) on a near real-time basis using a credit card clearinghouse. Reports are available for reconciliation of credit card activity from the RCSC as well as from the credit card clearinghouse. These reports are then reconciled with reports from the receiving bank. The reports are monitored for unusual activity such as excessive charges, credits or credit card discrepancies. Customers with pending expiration of credit cards are notified in the month prior to the expiration month.

4.9.4.4 Transponder Inventory

The RCSC will continue to manage a detailed inventory of the FasTrak transponders. The precise location (issued, lost, stolen, etc.), status and history of each transponder will be available at any time, and reports can be generated. The usual information maintained for each transponder includes:

- Current customer account assignment;
- Previous customer account assignments;
- External tracking number (serial number);
- Programmed type, facility code and tag ID;
- Manufacturer;
- Date received;
- Warranty expiration date;
- Status (e.g., issued, in stock, lost, stolen, under repair, retired, etc); and
- Location (RCSC, customer issued, destroyed, etc.).

4.9.4.5 Transponder Status Update

The RCSC will allow transponder status to be updated based on a reported condition of issued, lost, stolen, defective, damaged, destroyed, returned, etc. Transponder status information is maintained and a full history of status changes is retained.

4.9.5 Account Management System Reporting

Reports will be created as needed based on priority and importance. A suite of Smart Lane use reports will be made available to JPA staff by setting up administrative level access to the accounts database by BATA management personnel. Each report will be based on the retrieval of information from the production server (or backup database). The following major grouping of reports will be available:

- Account Management;
- Revenue Management and Finance/Reconciliation;
- Transponder Inventory;
- Marketing;
- Traffic and Revenues; and
- System Administration and Maintenance.

4.9.6 Financial Controls and Processes

The RCSC will have audit capability and will generate an audit trail for every transaction either created by or received into the system. The software provides monitoring and diagnostics capability.

Every backend process produces progress statistics that are logged to the database, log files and/or the System Event Log. Alarms are triggered when processes do not complete as expected. These alarms can be configured as e-mail or pager notifications to responsible operations staff.

Revenue is tracked by payment method, including cash, check, credit card and debit card.

The payment methods apply to the following types (and sub-categories within these types):

- Website payments;
- IVR payments;
- RCSC payments received by mail, phone-in or at the walk-in RCSC; and
- Payments from a collection agency (depending on the business rules).

4.9.7 RCSC System Access

The RCSC will have integrated access control mechanisms. Access to the system is controlled via security mechanisms implemented through the application software using security groups (all users belonging to a security group will inherit the access privilege of that group). Each log-in ID is associated with a security group that has pre-specified and limited access to application components (read/write, access to certain data, etc.).

Additionally, user passwords are encrypted using a real-time encryption scheme. If a user forgets their password, the System Administrator can only reset the password to some new value. The system requires passwords to be changed periodically. Access to certain critical system functions may require more than one password and user ID or more complex security measures.

5. CONCEPT FOR MARKETING THE I-680 SMART LANE

As opening day for the Smart Lane approaches, motorists will witness the unveiling of a new transportation infrastructure in the Bay Area, located in a travel lane that was previously reserved for carpools and transit vehicles only. The new HOV lane will be constructed to operate as a managed lane or HOT lane. For the first time, HOV users will be sharing the lane with SOVs.

The new infrastructure will require that both groups adapt to new rules. Carpoolers will have a limited number of points to enter and exit the Smart Lane; currently, the HOV lane permits continuous entering and exiting. The hours of operation for HOV users will expand to 24 hours per day, seven days a week from the current weekday peak-hour only operation. Carpoolers will find increased traffic in "their" lane, but the lane will continue to operate at highway speeds since it will be regulated by the dynamic pricing system. However, the MF lane users will experience less traffic in "their" lanes as SOVs switch to the Smart Lane. The uniqueness of this facility requires that the motoring public be educated as to how it will work and informed as to how to sign up for the ability to use it.

The Marketing Plan for the Smart Lane will define the unique experience of using the new service and include user perceptions about the ease of use, safety, reliability and customer service. The details of the marketing program will be provided in the Plan that will consist of an analysis of marketing conditions, definition of the market and audience, and a key issues outline. The Marketing Plan will also establish a mission and objectives for the marketing program and likely recommend an integrated campaign supported by media and advertising.

6. ANALYSIS OF THE I-680 SMART LANE SYSTEM

6.1 ACCESS

The collection of tolls from SOVs, while allowing HOVs, buses, motorcycles and other eligible vehicles to use the HOV lane free introduces several issues that must be resolved. One of the important issues to be addressed during the Project is the change in operations of the HOV lane upon the implementation of Smart Lane operations. Under the Smart Lane operation, limited access will be available to those vehicles that are allowed to utilize the HOV/Smart Lane, which is a change from the current HOV lane continuous access that is allowed.

6.2 TRANSPONDER READS IN NON-HOV LANES

Vehicles traveling in the MF lanes that are carrying transponders might have them read by the TZ detection equipment. This could result in user dissatisfaction and a loss of confidence in the ETS. The Smart Lane system will utilize technology that will greatly reduce the occurrence of cross-lane reads. This is not expected to be a significant issue since not all vehicles traveling in the MF lanes will have a transponder.

The JPA should develop business rules to address complaints resulting from cross-lane reads. For example, it is recommended that the activity for the transponder in question on the day in question be examined for other reads. If there is no further activity indicating a trip was made that day, the transaction should be adjusted to a zero toll.

6.3 SMART LANE CONGESTION

There will be occurrences when a traffic incident in or near the HOV/Smart Lane will cause traffic to slow significantly or stop. Since the ETS might not be able to adjust rapidly enough to prevent users from entering the Smart Lane during the incident, complaints may surface because the customer paid for a free-flow trip and it was not delivered. The JPA should consider nullifying the toll fee for those trips when a customer files a legitimate complaint.

6.4 HOV WITH TRANSPONDERS

Smart Lane customers who normally drive alone may occasionally use the HOV lane with two or more people in the vehicle. In such instances, they will be instructed to remove the transponder and place it in their mylar bag to prevent it from being read. However, failure to do so could result in a tag read and toll charge, which would make that customer dissatisfied when they receive their statement and see the erroneous toll charge. The JPA should institute a business rule that allows one toll transaction to be removed from a customer’s account for a given time period (one per quarter, one per year, etc.), for this occurrence.

6.5 LOST, STOLEN AND INVALID TRANSPONDERS

The Smart Lane ETS will not utilize typical video enforcement. As a result, preventing the use of lost, stolen or invalid transponders will be difficult. Enforcement of the continued use of these transponders will have to be done by CHP officers checking for these units at times of known use.

6.6 ENFORCEMENT

When the CHP identifies and tickets a Smart Lane violator, the citation will be written for an HOV violation, not for toll evasion. The processing of the citation will follow typical CHP HOV citation processing. For this reason, any revenues generated by the Smart Lane enforcement process are not envisioned to return to the JPA.

The inability to accurately identify the mix of toll-paying SOVs, HOVs and violators creates an environment where the impact of enforcement cannot be definitively measured. Too much enforcement may cause congestion in the HOV lane, and too little may result in customer dissatisfaction and lack of confidence in the Smart Lane. Therefore, periodic studies should be conducted to determine the violation rate and adjust the enforcement intensity to reflect the findings of those studies.