REVISED DRAFT

I-5 Columbia River Crossing Partnership: Traffic and Tolling Analysis

Sale/Distribution of Electronic Passes Including Fees and Potential Market Penetration

Working Paper 5.3

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PURPOSE

The purpose of this Working Paper (WP) is to discuss the basic components of Electronic Toll Collection (ETC), identify various approaches to the distribution of electronic "passes," and to discuss the potential ETC market share penetration that could be achieved in the I-5 Columbia River Corridor. The information presented reflects tolling experience in the Northeast U.S. and does not relate specifically to the I-5 Columbia River Crossing. However, the history will provide a basis for recommending variables that will be used in the tolling analysis.

ELECTRONIC TOLL COLLECTION

ETC is in widespread use throughout the U.S. and Europe and most commonly entails vehicle operators mounting a small transponder to the interior of their vehicle windshield. When the vehicle passes the toll collection point, it is electronically identified by a card reader mounted above the roadway and the proper toll is charged against a pre-established account. This transaction can take place either in a lane within the toll plaza or in a high-speed freeway lane separate from the toll plaza. The latter option is called open road tolling.

Depending on the pre-determined policy, open road tolling can also be available to users without a transponder and account by implementing a license plate verification system. Under this system, all vehicles that are not transponder-equipped have a series of video images captured of their license plates. Computers using optical character recognition software read the video image of the plate, and once the vehicle has been identified, its registration is checked through the various motor vehicle agencies to obtain a billing address. Once the address is obtained, a bill is sent to the owner of the identified vehicle for all trips occurring during a certain calendar period, as well as for handling fees that are used to cover the cost of this type of toll collection.

MARKET SHARE

This section of the WP summarizes various studies conducted by Vollmer Associates to estimate the practical limits of ETC based on their work in the Northeast United Statesm The findings in these studies can be used to estimate future ETC market shares (i.e., the percentage of vehicles using ETC). An assessment of the factors that influence ETC market share is first discussed, followed by a summary of marketing procedures.

Factors that Influence ETC Market Share

To determine the factors that influence ETC market share, a study of the various *E-ZPass* and other ETC system market shares in the U.S. was undertaken, including a review of the historical usage of ETC. This data leads to an examination of the relationship between toll road users and the frequency of trips made. *E-ZPass* is just one of several proprietary electronic tolling systems in use in the U.S. and is predominant in the Northeast where the studies were conducted. Another example that was not studied for this WP is the *FasTrak* system that is used in the San Francisco Bay Area.

E-ZPass allows users to pre-pay charges incurred at *E-ZPass* facilities. New York *E-ZPass* is operated under the auspices of the MTA Bridges and Tunnels, the New York State Thruway Authority, and the

Port Authority of New York and New Jersey. A customer's *E-ZPass* account is operable on all *E-ZPass* facilities in New York, Maine, Pennsylvania, New Jersey, Delaware, Maryland, and West Virginia. *E-ZPass* toll lanes are identified by a distinctive purple and white logo. In a toll plaza, a sufficient number of lanes will offer *E-ZPass* to accommodate the *E-ZPass* subscribers. These are the only lanes where the *E-ZPass* is accepted. If the *E-ZPass* customer uses other lanes, they will have to pay the full cash toll.

Historical ETC Usage

A review of current ETC usage at various toll facilities was conducted. Representative ETC market shares for various toll facilities are summarized in **Table 1**. Each agency is listed together with the date the first plaza opened, the typical discount rate, and the basic operating policies of the agency.

The market shares presented are for all vehicles on an annual basis and do not differentiate between passenger cars and commercial vehicles. Specific peak, off-peak, and daily periods may be substantially different. ETC discounts will vary from facility to facility and depend on the type of account that is held. The following link provides access to the various E-ZPass facilities: http://www.ezpassdrba.com/drba/static/info/index.html .

Table 1. Representative ETC Market Shares

Agency	Year Opened	ETC Discount	ETC Market Share (2003)
New York State Thruway	1993	None	54%
MTA Bridges and Tunnels	1995	12.5%	70%
Port Authority of NY and NJ	1997	16-33%	68%
Massachusetts Turnpike	1999	Some	51%
Delaware River Joint Toll Bridge Commission	2002	Some	44%
Delaware Memorial Bridge	2001	Some	44%
West Virginia Turnpike	2000	Some	20%
Garden State Parkway	2000	None	Est. 55%
New Jersey Turnpike	2000	Some	Est. 60%
San Joaquin Hills (CA)	1996	Some in recent years	64%
Foothills Eastern (CA)	1993-99	Some in recent years	59%

The West Virginia Turnpike has very little local (i.e., commuter) traffic, making the *E-ZPass* market share comparatively low at 20 percent. Conversely, several of New York City's MTA Bridges and Tunnels achieve 70 to 75 percent average annual market shares. With a high number of neighboring agencies and the captive audience of Staten Island and Long Island, this is considered to be approaching the absolute ceiling for *E-ZPass* market shares because drivers need to pay a toll to leave both islands. The Southern California toll facilities also achieve a high market share and electronic tolling is widespread throughout the area.

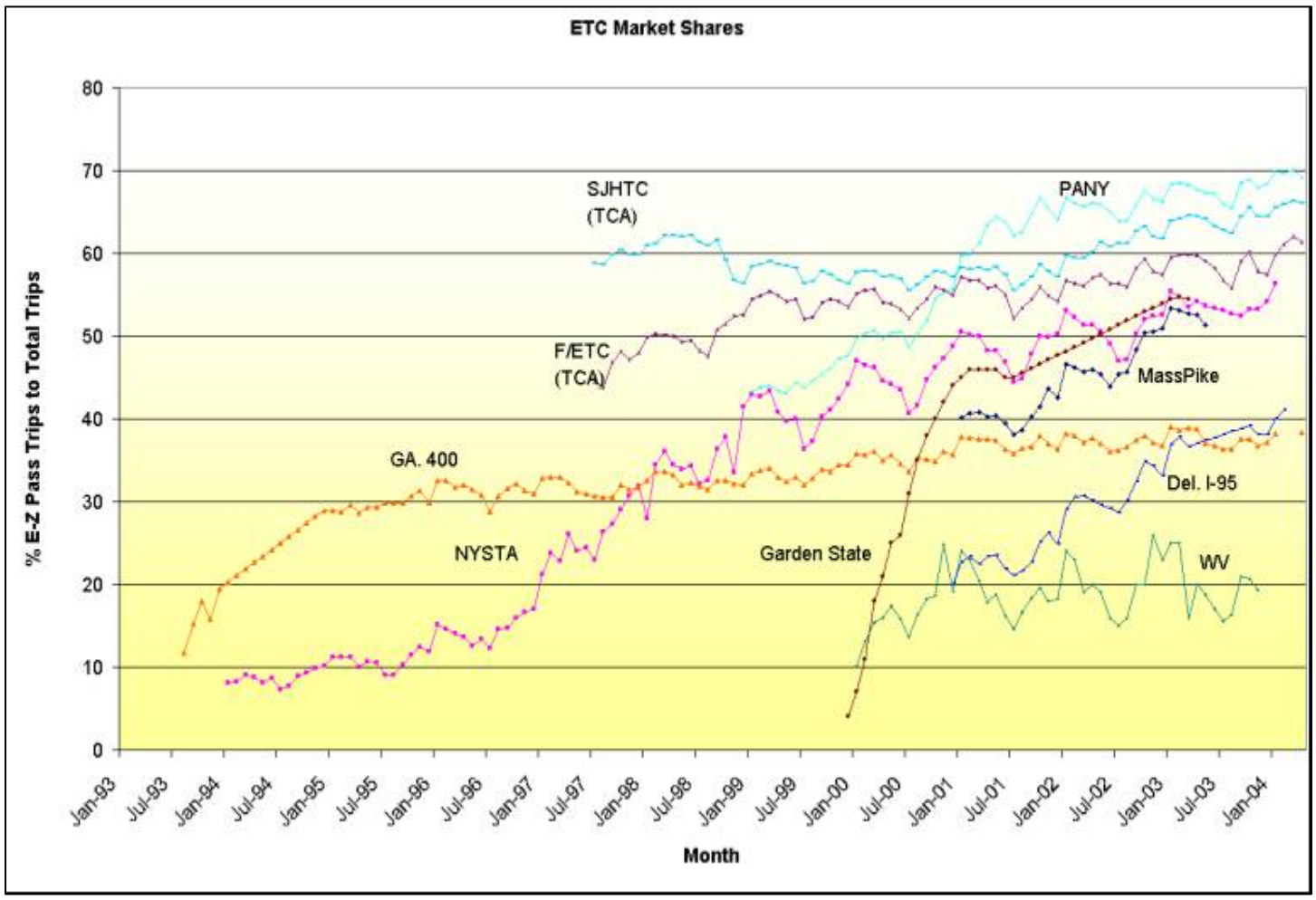
It is also important to note that ETC market share is a dynamic number that is influenced by many factors over time. There is an initial market share that typically includes the most frequent users. Middle frequency users tend to adopt the program during the first one to two years of operation, and occasional users tend to take two or more years to open accounts. There are also some casual users who are ETC users from other agencies that are present on day one.

Figure 1 includes the New York State Thruway (NYSTA), Garden State Parkway, West Virginia Turnpike, Massachusetts Turnpike, I-95 in Delaware, Port Authority of New York and New Jersey crossing, Georgia 400, and the San Joaquin Hills Toll Corridor and Foothills Eastern Tollroad in Southern California. Note that the California roads and the Georgia 400 use a technology similar to *E-ZPass* for electronic toll collection. The Georgia facility does not have reciprocal agreements with other agencies and is therefore most similar to the one under study. In some cases missing data was extrapolated pending the availability of the actual values from each agency.

Generally, the history of most *E-ZPass* roadways reflects a continued increase in *E-ZPass* market shares from opening day of ETC. Some roadways, such as the NYSTA, have experienced a leveling in the market share at specific facilities. The Thruway was the first agency to use *E-ZPass*, and in the initial period of operation, no neighboring agencies had adopted *E-ZPass* in the Northeast U.S. In the last several years, however, the installation of *E-ZPass* was completed on the NYSTA, the Port Authority Crossings (PANY), the MTA facilities, the Garden State Parkway, the New Jersey Turnpike and other agencies. This resulted in increasing the average thruway *E-ZPass* market share in 2003 to over 67 percent of all transactions at the Tappan Zee Bridge and to approximately 52 percent system wide.

Many facilities also exhibit seasonal variations in their *E-ZPass* market shares. The West Virginia Turnpike is one of the best examples of this variation. Summer peak traffic through the corridor typically does not come from users that frequently use *E-ZPass* facilities, and this shows as a reduction in *E-ZPass* market share. Interestingly, the total number of *E-ZPass* transactions actually increased during these periods due to the high summer volumes even though the market share as a percentage of all traffic decreased.

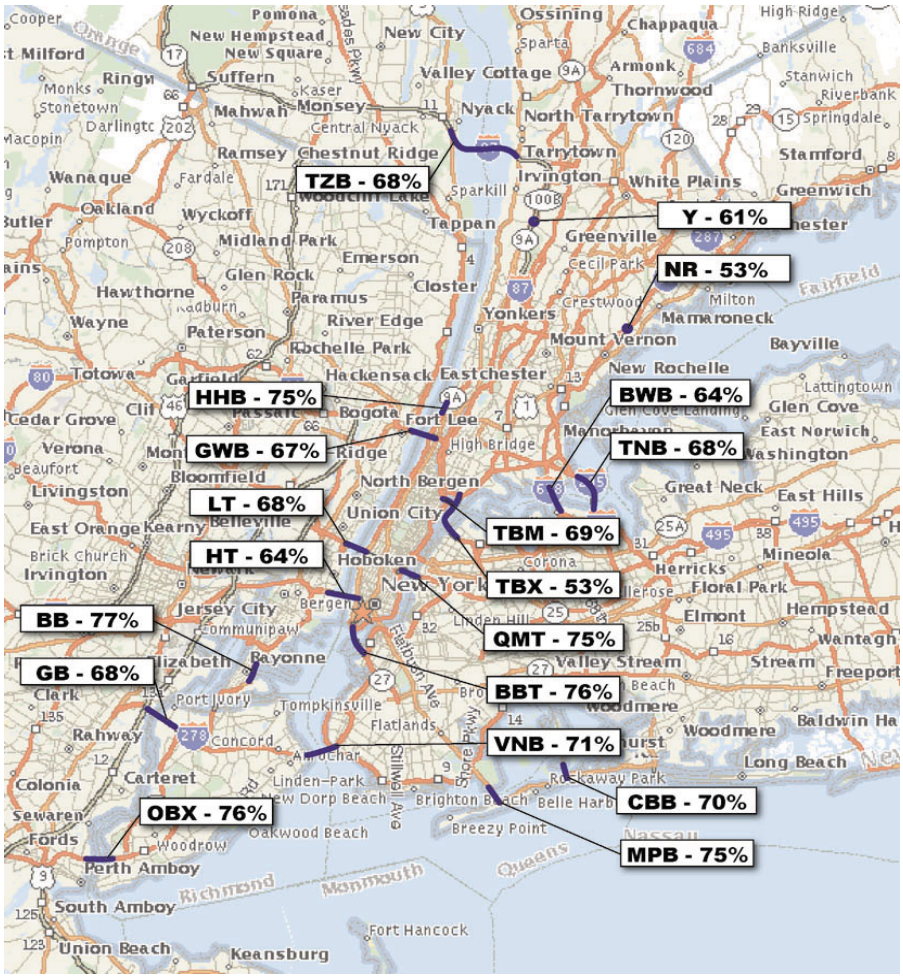
Figure 1. Historical ETC Market Shares



A review of the figure suggests that several factors are at play in the evolution of a toll system's market share of *E-ZPass* usage. The NYSTA continued to grow as other agencies were added to the *E-ZPass* system. However, some of those new agencies have exceeded the system-wide *E-ZPass* market share of the Thruway. Factors such as frequency of travel, proximity to other facilities, discounts, and travel time advantages all contribute. In reviewing the data, the single factor that correlates across the data best is frequency of travel. West Virginia's market share when compared to the Port Authority's is a strong example of this. **Figure 2** shows current *E-ZPass* market shares on the facilities surrounding the metropolitan New York City area, which range from 53 to 77 percent. These facilities carry a variety of traffic from commuters and local residents to long distance and interstate travelers.

As seen in Figure 2, market shares even vary at the different MTA facilities (BWB, TNB, TBM, TBX, QMT, BBT, CBB, and MPB) although the same toll discount is provided at each location. This behavior indicates other factors beside discounts influence market share.

Figure 2. Current *E-ZPass* Market Shares in the Metropolitan New York City Region



Even though the Triborough Bridge from Queens to Manhattan (TBM) and the Triborough Bridge from Queens to the Bronx (TBX) are located a few hundred yards away from each other, there is 25 percent greater market share at the Manhattan toll plaza. There are more high-frequency users on the bridge between the Bronx and Manhattan while there are more casual users on the bridge between the Bronx and Queens. Clearly, market share is dependent on the type of trip or user on the facility.

This is further illustrated by the Bayonne Bridge (BB), Cross Bay Bridge (CBB), and Marine Parkway Bridge (MPB), which all have very high levels of *E-ZPass* usage (over 70 percent market share). These bridges all lead to the residential communities of Bayonne, New Jersey and the Rockaway Peninsula in New York with no connecting through routes to these communities. People living in these communities are the most frequent users of the bridges, and their high adoption of *E-ZPass* results in a high percentage ETC use on these facilities.

Conversely, the New Rochelle toll plaza (NR) on the Thruway experiences the lowest *E-ZPass* usage in the region, even though it has three higher speed *E-ZPass* lanes (20 mph) that other facilities in the region do not have. Clearly, providing higher speed toll plazas did not influence the *E-ZPass* market share in a significant way because this plaza is located on I-95 and has numerous casual users making infrequent trips.

Toll Road Users, Trips and Frequency of Travel

This section explores the relationship between toll road users, trips made on the toll road, and the frequency of travel.

Surveys have been conducted on toll roads to determine the frequency of travel on an average day. The population sampled in the survey is assumed to represent the entire roadway driving population. The distribution of trips is calculated directly from the number of survey respondents in each frequency of travel category (e.g., trips made daily, once per week, once per month, and so on).

To calculate the actual distribution of driving population, several conversion steps are needed. First, the number of users per trip corresponding to each frequency of travel category is needed. If a driver is making a daily trip, no matter what day the survey is conducted, that driver and type of trip would be counted; therefore, only one facility user is needed to provide a "daily" response. If a driver is making a trip once per week, seven facility users, one for each day of the week, are needed to ensure that a "once per week" response would consistently occur. Once the number of different users needed for each frequency of use category is calculated, that number can be multiplied by the number of responses for each category to estimate the total user population.

Table 2 shows an example of the relationship between users and trips.

Assume two drivers travel through a toll plaza on a certain day and assume one is a driver who makes this trip every day, while the other is a driver who makes this trip only once a year. On an annual basis, those two trips will be made by 366 different drivers: the one driver who does it every day, and the 365 different drivers who only do it once a year. This illustrates the fact that while frequent users could be half or three-quarters or more of the toll plaza users on any given day, they would represent a much smaller share of all the *different* drivers passing through the toll plaza in a year.

Of the 15 respondents surveyed in the above example, five respondents reported making the trip daily. This represents 33 percent of all trips and translates into five users or two percent of the number of yearly facility users, as those respondents make the same trip every day. On the other hand, only one survey respondent reported making the trip twice per year, representing seven percent of all trips. Some 182 users (365 divided by two times per year) are needed on an annual basis for this trip response rate. This group accounts for 57 percent of all annual facility users.

Table 2. Example of the User/Trip Relationship

Frequency of Use	Number of Trips (1)	Percentage of Trips (2)	Annual Users for One Trip (3)	Total Users in One Year (4)	Percentage of Annual Users (5)
Daily	5	33%	1	5	2%
1/week	4	27%	7	28	9%
2/month	3	20%	15	45	14%
1/month	2	13%	30	60	19%
2/year	1	7%	182	182	57%
Total	15	100%		320	100%

Notes:

(1) Number of trips = number of survey responses for each frequency of use category.

(2) Percentage of trips = distribution of trips by frequency category.

(3) Annual users for one trip = number of users required annually to ensure one survey response for a specific frequency of use category.

(4) Total users in one year = number of annual users for one trip times the number of trips for each frequency of use category.

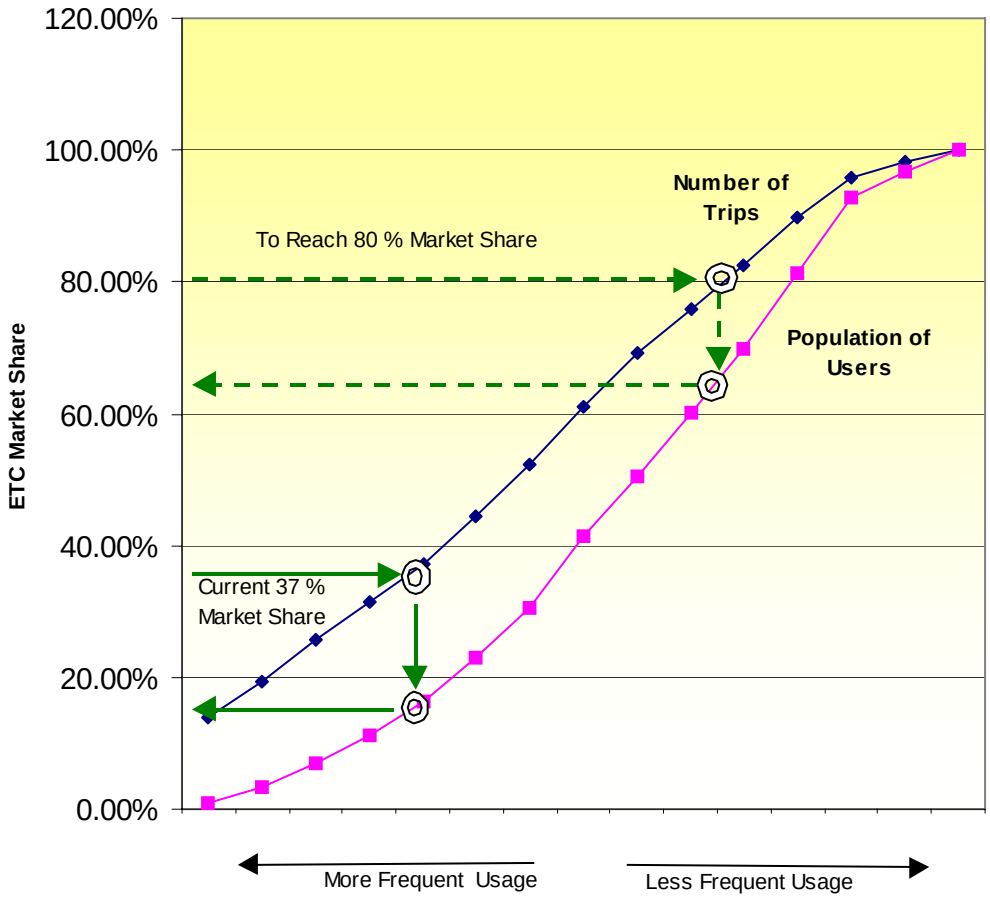
(5) Percentage of annual users = distribution of annual users by frequency of use category

This example illustrates the fact that while typically frequent users account for the majority of all trips, they comprise a small portion of the total users. Conversely, while occasional users account for a lesser number of trips, they typically comprise the majority of all roadway users. This relationship between frequency of travel, trips, and users is representative for most toll facilities.

Relationship of Market Share to Users

Figure 3 shows a graph based on a typical frequency of travel data that can be used to estimate the toll facility's market share based on the public's typical adoption rate of ETC. This representation is shown on the graph where currently 37 percent of all trips are made by ETC, but these trips are made by only 16 percent of users who are the more frequent users of the toll road. The graph depicts that for ETC market share to increase to 80 percent of all trips, the number of ETC users would have to increase to 65 percent of all users. This means that an increase in ETC market share from 37 percent to 80 percent (more than a two-fold increase) would require a corresponding increase in ETC users from 16 percent to 65 percent (more than a four-fold increase). Many of the less frequent roadway users would have to use ETC for this to occur.

Figure 3. Typical ETC Market Share Distribution



Forecast ETC Market Shares for Sample Facility

Applying all of the factors discussed above and adoption rates of other facilities, order of magnitude estimates of future ETC market shares for a sample toll plaza were made based on experience from the *E-ZPass* studies. Although the information may not reflect what will be experienced at the I-5 Columbia River Crossing, the ranges reflect current trends based on technology currently in use in the U.S. These estimates are presented in **Table 3**. It is reasonable to expect variations on an hourly, daily, and seasonal basis with higher market shares occurring during weekday commuter periods and lower market shares occurring during weekend summer travel periods when there are more occasional users.

Table 3. Total Forecast Market Share

Opening Year	3-5 Years After Opening	5-10 Years After Opening
25-30%	35-45%	50-60%

Marketing

There are a variety of ways to get transponders into the hands, or cars, of the traveling public. Transponders are primarily distributed through a Customer Service Center either through a walk-in procedure or over the telephone or Internet. These accounts can be established and secured with a credit card and are then activated when the driver receives the transponder.

Other programs that have been proposed involve selling transponders at travel centers and local drug stores. In this case, transponders would be available on a cash pre-paid basis, with a value stored on the card, very much like a pre-paid cell phone. This has not been undertaken at any scale in the U.S. as ETC programs have not yet needed the kind of instant marketing this program provides, but it is under serious consideration in Texas in their new turnpike program.

In order to maximize early transponder usage, extended grace periods, ETC/cash differentials, and easy account entry is the key to success. **Table 4** summarizes some of the issues and possible approaches to maximizing ETC usage.

Table 4. ETC Usage

Element	Marketing Approach	Possible System
1. Customer Treatment	Warm, welcoming during grace period Brochure to corridor travelers, local retail areas	Initial Sign: "I-5 Toll Bridge – No charge until Sept 2007
	Supporting signage	
	Initial opening: Free for all for 3 months Free for transponders for 3+ more months	Mid Sign: "I-5 Toll Bridge – No charge for Tag members until Dec 2007 Final Sign: "I-5 Toll Bridge"
2. TAG	Cost to reimburse	
	Grace period	No cost for 3 months; need credit card
	Cash	Full Cost: $20 as part of deposit
	Credit Card	Full Cost: deposit waived with credit card
3. Account	Monthly Fee	No cost for 6 months
	Transponder	Modest Value - $1 per month
	Commercial vehicles	$10 plus per month
4. Violation	Event trigger	After 3 months of free usage, violators are given one month to sign up
	Single transaction?	
	Several in 20-day period?	
5. Delayed Payment	Not an issue with pre-paid accounts	

CUSTOMER SERVICE CENTER

The Customer Service Center (CSC) is responsible for ETC promotion and marketing, patron account management, tag handling, customer service, system performance monitoring, revenue handling, and reporting. This section of the WP will provide a cost/benefit analysis based upon estimates and assumptions of setting up a CSC using DOT/Toll Agency resources versus contracting with a CSC

provider for the same services. When bidding the CSC project, it is typical to have four to six national companies take an active interest in the bid, with two to four companies ultimately submitting proposals. Specifically, the services provided by a CSC include:

- double-entry accounting system consistent with generally accepted accounting principals (GAAP),
- creating and maintaining pre-paid and post-paid patron accounts via walk-in, mail, telephone or internet,
- aging and collections from post-paid accounts,
- ETC transponders inventory control, tracking, and distribution,
- receiving and addressing account inquires via mail, telephone, or internet,
- producing and distributing account statements,
- producing and distributing patron correspondence,
- processing cash, credit card check, and ACH payments for service,
- performing cash drawer reconciliation,
- handling credit card auto-replenishment functionality,
- providing reports for double entry accounting audit, batch control totals, checks and balances, and revenue reconciliation,
- maintaining special discount programs, and
- processing and creating tag status files between the CSC and Host computer.

Comparative CSC Operations and Costs

Quantifying costs for a system requires further development of policy, traffic, and revenue before an analysis can be made for the I-5 River Crossing. However, a comparison of features, benefits, and risks and sample costs can be made for different CSC operations.

Comparative costs include appropriate capital and operating costs for each alternative. Several items that would be common to either choice are not included in this discussion. They include:

- No consideration was made for walk-in storefronts.
- A video enforcement program was not considered in this analysis, but will be the subject of future work (WP 7.1).
- Net revenue implications associated with each market share alternative are not considered.
- Credit card fees are not considered.
- Cost escalation is assumed to be the same for all cases.

CSC Scale of Operations

The first step in analyzing the cost of a CSC is to determine the scale of operations projected for the CSC. The principle factors determining the size of the CSC operation are the number of accounts, tags, and transactions projected to be processed by the system. Vollmer Associates has analyzed various ETC implementation scenarios in previous studies for numerous clients.

Basis for Cost Estimates

There have been several recent procurements for CSCs, each resulting in a very wide range of estimated costs. Some of the variance is based upon the scope of services specified, the anticipated size of the operation, and what appears to be market forces. As such, per transaction costs have ranged from as low as $04.5 per transactions to costs in excess of $.25. Clearly, the range is so wide that a direct comparison between an outside provider of the service and developing an internal DOT service center is difficult. Given this task we have made the following assumptions in establishing our cost comparisons:

- DOT operating costs must include depreciated capital costs for a CSC because those costs would be included in the unit costs of an outside service provider.
- Most recent published cost data assumes statements will be issued six times annually, therefore we considered for comparison purposes 6 statements per account per year.
- The turnover rate of new and replacement transponders will range between 10 and 15 percent of the projected total annually.
- The customer service center will be responsible for printing- and distribution-related marketing costs.
- Cost estimates will be based on a low and high range of expected ETC market shares.
- The two ETC market share scenarios will have a subsequent low and high range cost estimate.

CSC Operational Scenarios

Four CSC operational scenarios were considered including 1) In-House Operations, 2) Flat Fee Plus Fixed Cost Per-Transaction, 3) Straight per Transaction Cost, and 4) Cost for Services.

In-House Operations

The first alternative evaluates the cost and effort required by the DOT/Toll Agency staff to handle all CSC service activities in-house. Such services will include all CSC activities defined earlier as well as addressing all the basic needs for setting up office space. Issues related to in-house operations:

- Past performance indicates this is the best choice when there are few accounts with a small market share.
- There is no economy of scale as market share increases, in fact as market share grows the overall cost increases. The rate of growth in number of accounts is greater than the rate of growth in transactions.

- In-house systems assume all development and operational risks, no existing service center to fall back on.
- An undersized CSC could not respond to higher than expected demand for services in a timely manner. The difference between a 30 percent and 40 percent transaction market share may require a 50 percent larger CSC to handle the increased number of accounts.
- An oversized CSC could result in high costs distributed across few transactions.

Flat Fee Plus Fixed Cost per Transaction

In this alternative, a minimum annual fee is set to cover the basic costs associated with another entity operating a CSC—this removes market share risks. Per-transaction costs are then assigned for transactions above a set threshold. The threshold should be established as close as possible to the anticipated market share.

- This approach has a consistent basis for estimating future costs.
- Costs are not as sensitive to market shares.
- A large existing CSC can more easily react to changes in market share than an in-house system. For example, our market share range approximately doubles the number of accounts for the in-house system, but that 80,000-account difference is minor in a large existing CSC with over 1,000,000 existing accounts.
- Lower startup risk as compared to the in-house alternative.

Straight per Transaction Cost

The purpose of this cost estimate is to "charge" all processing costs. Since this is a charge for services, it is a reasonable method for estimating the anticipated costs for these services. Recently, the compilation of several CSCs resulted in an average cost to be $0.125 per transaction. It should be noted that this is an average cost, and should only be used as reference because it includes agencies with service centers processing from 15,000 accounts to some 3,000,000 accounts in a single service center.

Cost for Services

Some recent procurements have established a "cost for services" approach as a basis for providing CSC services. Specific services included:

- Start-up costs
- Per-transaction cost
- Cost per new transponder shipped
- Cost per active account services

The start-up cost covers any special programming required to meet the specific needs of the DOT or Toll Agency. The per-transaction cost is set to cover the costs of operations, posting, reciprocity, and other volume based transactions. Per-transponder costs cover the opening of accounts and issuing of

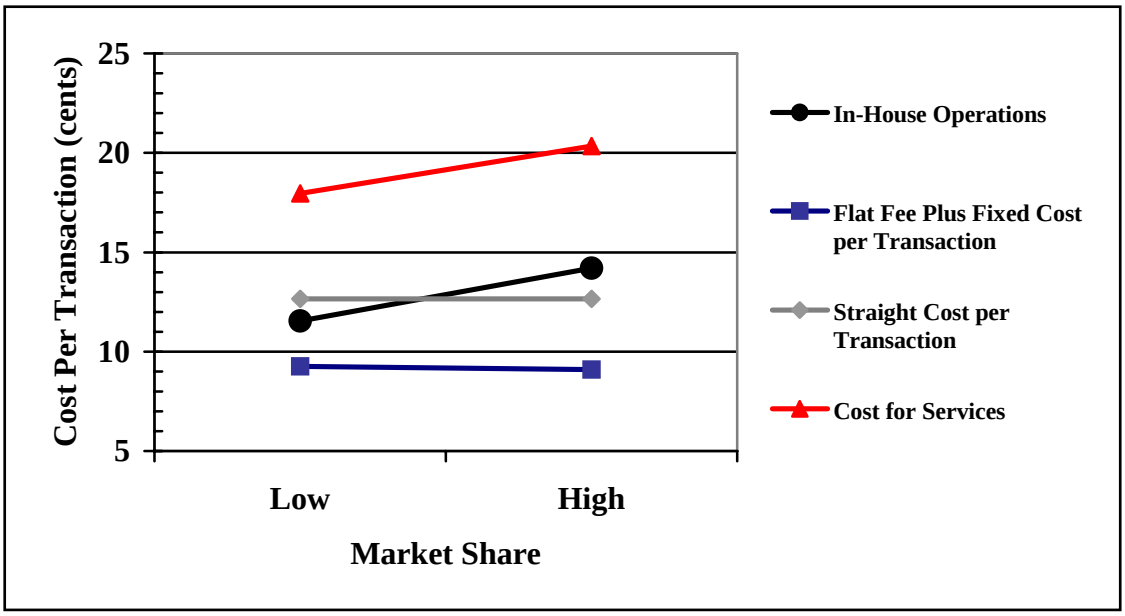
transponders. Per-account charges are typically used to offset the costs of preparing statements and communicating with customers.

- An advantage is that you only pay for what you use.
- Disadvantage is that risk is priced into unit costs.
- This appears to have resulted in higher costs in recent procurements as market shares increased.
- Costs not as sensitive to market shares as in-house, but more sensitive than flat fee plus transaction based.
- Large existing CSCs will not react to changes in market share as severely as an in-house system. For example, our market share ranges approximately doubles the number of accounts for the in-house system, but that 80,000-account difference is minor in a large existing CSC with over 1,000,000 existing accounts.
- Lower start-up risk as compared to in-house alternative.

Estimated Annual Operating Costs

Figure 4 is a graphical presentation of the average cost per transaction for a high and low range market share case for the in-house, flat fee, and cost for services analyses.

Figure 4. Comparison of Estimated Operating Costs for a Customer Service Center by Operating Scenario



As stated, these cost estimates are for a sample system. These do not apply to the I-5 River Crossing project, but provide an example as to the approach to be used in developing these costs. Also, these costs do not include credit card fees, which are highly variable and can range between $.02 and $.05 per transaction.

RECOMMENDATIONS

There are many policy decisions that must be made before an ETC system can be developed. The important factor in developing a system is the potential market share and the makeup of the traffic. Frequent users will likely be the early ETC users, and less frequent users will follow. The presence or absence of other tolled facilities in the region will also impact the potential market share numbers. An opening year market share penetration for the I-5 Columbia River Crossing could be estimated at 25-30 percent. An established system may achieve between 50-60 percent market share, depending on whether or not a discount program is implemented and to what extent it benefits the drivers.

In later work products, we will suggest marketing techniques, prices, strategies and incorporate data on travel patterns to determine how an ETC system might be employed. For costing purposes, we recommend assuming a conservative per-transaction cost of ETC to be $.20 per transaction. The cost of manual transactions will be established when the toll rates are set, since the cost is based on the number of manually staffed lanes.