ORANGES Evaluation Test Plans

Analysis of Before Data Collected for the US DOT sponsored Evaluation of the ORANGES Electronic Payment Systems Field Operational Test

US DOT/Volpe National
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Foreword

This document is one of a series of working papers that report on progress for the US DOT evaluation for Phase I of the ORANGES field operational test. Each working paper corresponds to a Phase I task. At the conclusion of Phase I, these documents will be updated and compiled to form a final report. Phase I documents include:

- Evaluation Strategy and Plan – issued November 6, 2001
- Test Plans – issued January 20, 2003
- **Statistical Analysis of Before Data – this document**
- Risk Assessment

This document provides the data assessment identified in the test plans, for quantitative goals where the assessment of "before" data was applicable, using the data available from the implementing agencies. This document also identifies some distinctions between the data that was obtained and the data that was anticipated in the test plans document. The assessment of qualitative data will be provided in separate documents addressing the "before" and "after" discussion groups.

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1 Introduction

This document describes the quantitative "before" data provided by the participating agencies for the Orlando ORANGES multi-modal Field Operational Test (FOT) as part of the US DOT's evaluation effort, and provides a statistical analysis of that data. The analysis of qualitative discussion group data will be provided in a separate document. The data collection and analysis effort has been undertaken in accordance with the test plans established in advance.

Table 1 identifies specific by mode, the quantitative goals discussed in the test plans that involve before data collection.

Table 1. Quantitative Goals By Mode that require Before Data Collection

Quantitative Goals	Facility Type		
	Transit Buses	Parking Garages	Toll Lanes
Goal 1 – Clearinghouse Performance Measures			
Goal 2 – Acceptance Test Results			
Goal 3 – Demonstrate Performance for New Transponders			
Goal 4 – Transaction Times	✔	✔	
Goal 5 – Prepaid Revenue Share	✔	✔	
Goal 6 – Automated Equipment Uptime	✔		✔
Goal 7 – Joint Account Use			
Goal 8 – Current Pass Distribution and Permit Billing Costs	✔	✔	
Goal 9 – Current Processing Cost per Cash Transaction	✔	✔	✔

The document begins with a background description of the FOT. Then, for each goal involving before data collection, the document reviews the selected measure and discusses, separately by mode, the data collected and the analysis.

2 Background Description of the ORANGES Field Operational Test System

The FOT has implemented a central stored value system – using a clearinghouse system to be operated by Touch Technology Inc. (TTI). Payment transactions with smart card readers operated by individual agencies are transmitted to the ORANGES clearinghouse for reimbursement. The long-

term ORANGES plan involves Central Florida residents and tourists using the prepaid accounts for many purposes.

The FOT involves a limited deployment:

- Card base: The agencies plan to maintain 800-1200 smart cards in active use at all times during the test.
- Transit deployment: LYNX has equipped Links 13 and 15, which both connect post-secondary educational institutions with the downtown area.
- Toll deployment: The Orlando-Orange County Expressway Authority (OOCEA) is equipping selected lanes of the Holland East toll plaza on State Route 408 to accept the Efkon transponder with a smart card as well as installing smart card accepting validators in selected manual lanes. Smart card acceptance through transponders was deferred one or two months from the initial deployment. The Holland East plaza is a 14-lane facility. Lanes 1-6 operate westbound, lanes 9-14 operate eastbound, and lanes 7-8 are reversible.
- Parking deployment: The City of Orlando Parking Bureau has equipped cashier booths in the Central Boulevard, Library and Market Street garages.
- Revaluing facilities: Each agency offers facilities for smart card issuance and revaluing. This includes points of sale at agency-operated customer service facilities, selected attended toll lanes and some locations operated by third parties (additional details on revaluing locations and payment methods accepted are provided below). Passes will continue to be sold only through LYNX facilities and transponders will continue to be only available through OOCEA facilities.

2.1 OOCEA

Rather than integrate the existing E-PASS Electronic Toll Collection (ETC) system with the smart card clearinghouse, the ORANGES partners have opted to create a parallel ETC system in equipped lanes, using Efkon smart card accepting transponders and smart card validators.

Figure 1: Transponder that Accepts Smart Cards

Source: ORANGES Consortium

Smart Card Accepting Transponders

The OOCEA customer service center will distribute the Efkon smart card accepting transponders in addition to conventional transponders (see Figure 1). Customers will insert the smart card into the Efkon transponder slot to have their toll deducted

from their ORANGES account, as an alternative to payment by cash or payment from the conventional OOCEA transponder account.

Efkon transponders use infrared communications with the laneside readers. Readers will be integrated with the clearinghouse, bypassing the existing ETC system. OOCEA customers receiving an Efkon transponder for use with the equipped toll plaza lanes will continue to use their conventional transponder for non-equipped toll lanes. The conventional transponder is also read by the Holland East plaza equipment, which activates the "paid" laneside signal (the OOCEA account is also charged in the process, but this is reversed out when there was a corresponding payment from the ORANGES account).

Smart Card Validators

Selected manual lanes are also equipped with validators (see Figure 2), similar to those used for payments at parking garages and LYNX buses. The validators allow customers with an ORANGES smart card to pay tolls by stopping and placing the smart card in proximity to the validator mounted in the lane, as an alternative to cash. In contrast to the validators being used for parking and transit, Efkon supplied these validators. The validators and point of sale devices connect with the ORANGES clearinghouse.

Figure 2: Toll Lane Smart Card Validator

Source: ORANGES Consortium

2.2 LYNX

All buses have registering fareboxes, which LYNX recently replaced with a new model. Rather than purchase new fareboxes with an integrated smart card reader, with only certain smart cards supported by the vendor, the ORANGES partners opted for stand-alone validators from Ascom Transport Revenue Systems (see Figure 3). These are mounted beside the fareboxes but not integrated with them. The ORANGES card will be used as an alternative to cash and the LYNX monthly pass.

Figure 3: Stand-Alone Transit Smart Card Validator

Source: ORANGES Consortium

2.3 City of Orlando Parking Bureau

Selected garages accept the ORANGES card using a validator (see Figure 4). The ORANGES card will be an alternative to cash. The transaction data is transferred to the ORANGES clearinghouse after being consolidated by the Parking revenue management system.

Figure 4: Parking Garage Validator

Source: ORANGES Consortium

2.4 Smart Card Issuance and Revaluing

Cards are initialized centrally, and initially distributed to the cardholders by mail. Cardholders use one of the revaluing points to add a balance or a LYNX pass to the card. Replacement cards will still be initialized centrally and then distributed either by mail or through one of the revaluing locations.

Table 2 summarizes the available revaluing locations and the payment methods accepted at each:

Table 2. Revaluing Locations and Payment Methods Accepted

Agency	Revaluing Location	Payment Methods Accepted		
		Cash	Check	Credit Card
Parking Bureau	Central Boulevard Garage – Cashier Booth	✔	✔	
	Central Boulevard Garage – Payment Office	✔	✔	✔
	Market Garage – Cashier Booth	✔	✔	
	Library Garage – Cashier Booth	✔	✔	
LYNX	Downtown Bus Terminal – Sales Window	✔	✔	
	Valencia Community College East – Book Store	✔	✔	✔
	University of Central Florida – Student Union Ticket Office	✔		
OOCEA	Holland East Toll Plaza – Designated Staffed Lanes	✔		
	East Side Service Center	✔	✔	✔

Some automatic revaluing arrangements are also available:

- LYNX offers automatic pass renewal. Customers register by providing a credit card number, which will be charged once a month prior to month end. This pass renewal will be updated on the card when it is used at a LYNX validator after the credit card transaction has been completed.
- OOCEA offers automatic account stored value replenishment. Again, customers register by providing a credit card number. The credit card will be used to add $20 to the account whenever the balance drops to $5 or less.

Cardholder Participation Incentives

The agencies are offering several cardholder participation incentives:

- Cardholders receive a 15% discount on regular LYNX fares (i.e., $1.06 instead of $1.25);
- Parking customers receive 50% off hourly and daily parking fees; and
- OOCEA customers receive a smart card with $5 preloaded, and a $20 check at the end of the 12-month trial if they have remained an active user throughout the FOT period.

2.5 Clearinghouse

The primary role of the clearinghouse is to settle prepaid funds between the participating agencies, using bank accounts for each agency and an intermediate "clearing account".

If, for example, a cardholder is issued a card from LYNX and prepays $30, these funds are initially held by LYNX even though the cardholder might make payments at equipped facilities operated LYNX, OOCEA or Orlando parking. If during a certain settlement period this Lynx card were used to make $3 in payments at OOCEA and $1 in payments at parking garages, the clearinghouse would execute the settlement by transferring these amounts from the LYNX account to the accounts of the other agencies.

Additionally, if the LYNX cardholder makes the initial prepayment at a revaluing device operated by another agency, the funds will be initially placed in the account of the agency that receives the revaluing payment from the cardholder. However, the settlement process is used to transfer the funds to LYNX.

One other feature that LYNX has opted to maintain is two accounts. One account is a funds pool account for holding prepaid funds that have not yet

been used by the cardholders for purchases. The other is a revenue account for holding funds received for LYNX purchases. Funds from the purchase of LYNX passes are transferred from the funds pool account to the revenue account during the next settlement, while stored value is not transferred to the revenue account until used for payment transactions. The other two agencies are using a single combined purpose account.

The various funds movements that that are to occur in and out of each agency account are consolidated into net transfers with the clearing account, in or out of each agency account. Table 3 provides sample reconcilement information that summarizes the derivation of the net settlement payments. When a card issued by a certain agency is used for purchases or loads at that agency's equipment, no funds transfer is required.

Table 3. Sample Clearinghouse Settlement Activity

	E-CASH ACTIVITY AND SOURCE						Net To/From Funds Pool
	LYNX		OOCEA		City Parking		
LYNX	$ (1.00)	$ 36.50	$ (0.75)	$ -	$ -	$ -	$ 34.75
OOCEA	$ (0.75)	$ -	$ (341.79)	$ 780.05	$ (2.50)	$ -	$ 435.01
City	$ (3.00)	$ -	$ (26.25)	$ 50.00	$ (114.50)	$ 424.19	$ 330.44
	$ (4.75)	**$ 36.50**	**$ (368.79)**	**$ 830.05**	**$ (117.00)**	**$ 424.19**	**$ 800.20**

Accounts

LYNX Funds Pool	$ (1.00)	To LYNX Revenue for e-cash purchases
	$ (277.10)	To LYNX Revenue for pass purchases
	$ (0.75)	To OOCEA for purchases
	$ (278.85)	**Net to Clearing Account**
LYNX Revenue	$ 1.00	From LYNX FP for e-cash purchases
	$ 277.10	From LYNX FP for pass purchases
	$ 0.75	From OOCEA for purchases
	$ 3.00	From City for purchases
	$ 281.85	**Net from Clearing Account**
OOCEA	$ 0.75	From LYNX FP for purchases
	$ 26.25	From City for purchases
	$ (0.75)	To LYNX Revenue for purchases
	$ (2.50)	To City for purchases
	$ (50.00)	To City for loads
	$ (26.25)	**Net to Clearing Account**
City Parking	$ 2.50	From OOCEA for purchases
	$ 50.00	From OOCEA for Loads
	$ (3.00)	To LYNX Revenue for purchases
	$ (26.25)	To OOCEA for purchases
	$ 23.25	**Net from Clearing Account**
	$ (305.10)	**Total credits to Clearing Account**
	$ 305.10	**Total debits to Clearing Account**

3 "Before" Data Analysis for Quantitative Goals

For each evaluation goal requiring "before" data collection, this section describes :

- the selected measure and (where applicable) the test hypothesis;
- a description of the "before" data collection process (types of data, methods of collection, time periods and facilities), separated by mode, and;
- the analysis performed by the evaluation team.

The data collected for most of the measures is only a sample, so statistical analysis was performed by the evaluation team. This is important because unforeseen circumstances can cause the variations in data. For example, the duration for a set of boarding transactions varied due to factors such as how long people take to pay with cash or whether the driver is asked for directions. The estimates for pass distribution, permit billing and cash processing costs are not samples and thus did not need statistical analysis.

First, the evaluation team calculated the average and standard deviation. Using the standard deviation (a measure of how widely dispersed the sample observations may be) and the sample size, a statistical inference statement was developed. This was of the form, "With a 95% level of confidence, the overall population average for this sample is expected to lie within the following range around the sample average".

This expected range is known as the confidence interval, and can be expressed as a precision percentage. For example, a range from 75 to 125 around an average of 100 can be expressed as +/- 25% precision. The statistical relationship for the precision percentage (for the 95% confidence level) can be expressed with the following formula:

- $P = ((1.96*\sigma)/\sqrt{N})/X$

  Where:
  P = Precision percentage
  X = Average
  σ = Standard Deviation
  N = Sample Size

3.1 Quantitative Goal 4 – Reduce Transaction Times

Reducing average transaction times is important for all three modes and can translate directly into reduced queuing and bus dwell times. This quantitative

goal has not been applied to tolls for the evaluation, since the percentage paying by transponder or smart card will not noticeably increase within the high volume of daily plaza transactions.

Measure

- Average payment transaction duration, for each mode and type of equipment.

Test Hypothesis

- Prepaid payment transactions will be quicker than cash payment, so the average duration will decrease if the % prepaid increases.

Data Collection and Analysis

Parking

At each of the three equipped parking garages (Central Boulevard, Library and Market), a Parking Bureau observer recorded the duration for a sample of payment transactions at the cashier booth. The transaction time was taken as the vehicle stopped time at the booth.

Table 4 summarizes the sample size, average, standard deviation, and precision percentage for each of these samples. The confidence intervals on the average for each garage are similar enough that it seems reasonable to combine the garages together into a single large sample. For all garages together, we make the following statistical statement:

- Three garages combined: At the 95% confidence level, the average transaction time is expected to be 23.3 s +/- 5% (i.e., between 22.1 and 24.5 seconds, 95% of the time).

Table 4. Statistical Analysis of Parking Transaction Times Data

Garage	Sample Date	Sample Size	Average (s)	Standard Deviation (s)	Precision
Central Boulevard Garage	1/15	60	**23.4**	20.4	22%
	2/20	60	**23.9**	13.4	14%
	3/17	60	**22.7**	15.2	17%
	4/14	60	**23.3**	22.1	24%
	5/16	60	**18.8**	7.5	10%
	Combined	**300**	**22.4**	**16.5**	**8%**
Library	1/16	60	**22.1**	8.6	10%

Garage	Sample Date	Sample Size	Average (s)	Standard Deviation (s)	Precision
Garage	**2/18**	60	**25.6**	10.1	10%
	3/20	60	**19.8**	18.2	23%
	4/25	60	**25.9**	17.0	17%
	5/28	62	**25.4**	12.8	13%
	Combined	**302**	**23.8**	**14.0**	**7%**
Market Garage	**1/16**	60	**24.2**	12.5	13%
	2/20	60	**25.6**	44.9	44%
	3/18	60	**23.4**	10.1	11%
	4/24	60	**24.9**	17.6	18%
	5/14	62	**20.2**	17.2	21%
	Combined	**302**	**23.6**	**23.9**	**11%**
All Garages Combined		***904***	***23.3***	***18.6***	***5%***

Transit

On buses for each of the two equipped LYNX bus routes (Links 13 and 15), the Automatic Passenger Counting (APC) equipment was used to gather data during selected weeks when these buses were in use on these routes (only a subset of the LYNX bus fleet is APC-equipped). The APC equipment records at each stop the number of passengers that boarded and alighted as well as the duration the doors were open.

Several data filtering steps were taken to help construct samples where the duration the doors were open could be divided by the number of boarding passengers at that stop to best represent the average transaction time per boarding passenger at that stop.

- LYNX filtered out stops entries that were timepoints/layovers (either due to it being a known characteristic of the stop, excessive dwell time or having no passenger activity), or for some other reason might have involved the doors being open longer than needed for passenger movement alone.
- An additional filtering step by the evaluation team removed any remaining stop entries that involved at least 120 seconds per boarding passenger. It was assumed that these represented unrecognized delays beyond what was needed to board passengers (e.g., time points/layovers). This was a judgment in the sense that all longer durations per passenger (e.g., greater than about 30 seconds per passenger) might be of this type. On the other hand, some of these longer durations could be legitimately associated with a boarding passenger (e.g., trouble finding change or a fare dispute). Implicit

in the test hypothesis is the expectation that the smart card would tend to reduce the incidence of longer fare payment events. So, retaining the somewhat longer duration stop entries in the samples (i.e., the longer ones that are less than 120 seconds) is intended to capture situations that may be mitigated by the smart card.

- The evaluation team noted that some stop entries seem infeasible (e.g., several people boarding within 1-2 seconds). This could indicate a bias in the behavior of the APC equipment (e.g., over counting boardings, undercounting the duration of the door opening). There is no reason to believe that the underlying cause of these is limited only to these stop entries, and these have not been eliminated from the sample to avoid introducing a bias against short duration stop entries. It is assumed that these effects will be prevalent to a similar degree in the before and after testing (i.e., so that they balance out in the before vs. after comparison).
- Passengers simultaneously board (through the front door) and alight (through the rear door). LYNX filtered out stop entries where the number of alighting passengers exceeded the number boarding, in which case the duration of the doors being open would not have been governed by the number of boarding passengers.
- An additional filtering step undertaken by the evaluation team was to remove stop entries listing a dwell time of zero, since these entries apparently represent faulty data.

Table 5 summarizes the sample size, average, standard deviation, and precision percentage for each of these samples. Sample sizes provided by LYNX are substantially different, relative to the time periods covered. LYNX sometimes has dates when some APC data is missing, which accounts for these differences, although these occurrences are random and each sample should still remain representative (i.e., similar averages in the various samples). The confidence intervals on the average for each route are distinct enough that it seems reasonable to not combine the routes together into a single large sample. For these routes, we make the following statistical statements:

- Link 13: At the 95% confidence level, the average transaction time is expected to be 13.0 s +/- 4% (i.e., between 12.5 and 13.5 seconds, 95% of the time).
- Link 15: At the 95% confidence level, the average transaction time is expected to be 10.6 s +/- 3% (i.e., between 10.3 and 10.9 seconds, 95% of the time).

Table 5. Statistical Analysis of Transit Transaction Times Data

Bus Route	Sample Date	Sample Size	Average (s)	Standard Deviation (s)	Precision
Link 13	**12/2-12/6**	79	**9.7**	10.4	23%
	12/9-12/13	303	**13.0**	11.2	10%
	1/26-2/1	686	**12.8**	13.7	8%
	4/1-4/14	275	**14.6**	19.1	15%
	6/25-6/30	920	**12.9**	13.3	7%
	Combined	**2263**	**13.0**	**13.9**	**4%**
Link 15	**12/2-12/6**	490	**10.3**	7.4	6%
	12/9-12/13	442	**10.5**	7.6	7%
	1/26-2/1	569	**10.8**	11.6	9%
	4/1-4/14	275	**11.6**	11.2	11%
	6/11-6/17	119	**11.8**	9.2	14%
	6/20-6/30	933	**10.2**	7.5	5%
	Combined	**2828**	**10.6**	**9.0**	**3%**

3.2 Quantitative Goal 5 – Increase Prepaid Revenue Share

The agencies wish to (1) reduce cash handling costs and (2) increase the "float" investment revenue earned from holding prepaid revenue. However, changes in cash handling costs and float revenue are not expected due to the limited scale of deployment. Prepaid revenue share was selected as a measurable surrogate quantitative goal for equipped facilities. It is necessary to determine whether some of the ORANGES card usage is displaced from other prepaid payment methods rather than from cash. For this reason, we look at the overall percentage using any prepaid method, rather than only the % using the ORANGES card. This goal has not been applied to tolls for the evaluation, since the percentage paying by transponder will not noticeably increase within the high volume of daily plaza transactions.

Measure

- % of transactions that use a prepaid revenue payment method

Test Hypothesis

- % prepaid transactions will increase for equipment accepting the ORANGES card.

Data Collection and Analysis

Parking

The Parking Bureau was able to provide monthly summaries for each parking garage over the period from October 2002 through March 2003, indicating the amounts received for the following types of parking payment methods:

- Monthly parking permits – a prepaid method;
- Transient parking – cash payment at the exit cashier booth;
- Evening parking – cash payment on entry during the evening hours, so that the exit cashier booth can be unattended.

Table 6 presents this data (rounded to the nearest dollar). For each garage, the percent prepaid varies from month to month, so an overall percentage was not calculated for each garage. Instead, a statistical analysis was performed:

- Central Boulevard Garage: At the 95% confidence level, the average prepaid revenue share is expected to be 52% +/- 12% (i.e., between 45% and 58%, 95% of the time).
- Library Garage: At the 95% confidence level, the average prepaid revenue share is expected to be 46% +/- 16% (i.e., between 39% and 53%, 95% of the time).
- Market Garage: At the 95% confidence level, the average prepaid revenue share is expected to be 47% +/- 14% (i.e., between 40% and 54%, 95% of the time).

Table 6. Parking Prepaid Revenue Share Data

Garage	Month	Prepaid	Cash	Total	Prepaid Revenue Share
Central Boulevard	October	$84,863	$51,390	$136,253	**62%**
	November	$69,492	$45,561	$115,053	**60%**
	December	$56,709	$69,174	$125,883	**45%**
	January	$63,953	$59,772	$123,726	**52%**
	February	$57,552	$61,458	$119,010	**48%**
	March	$58,530	$77,712	$136,241	**43%**
Library	October	$43,739	$36,146	$79,885	**55%**
	November	$27,363	$33,567	$60,930	**45%**
	December	$44,029	$40,579	$84,608	**52%**
	January	$42,292	$37,073	$79,364	**53%**

Garage	Month	Prepaid	Cash	Total	Prepaid Revenue Share
	February	$26,764	$52,989	$79,753	34%
	March	$32,961	$58,696	$91,657	36%
Market	October	$15,228	$24,827	$40,055	38%
	November	$19,446	$25,726	$45,172	43%
	December	$22,040	$28,643	$50,682	43%
	January	$20,776	$26,132	$46,909	44%
	February	$6,606	$5,348	$11,953	55%
	March	$15,632	$11,075	$26,708	59%

Transit

LYNX was able to provide monthly summaries for the fareboxes on each route over the period from November 2002 through March 2003, indicating the percent of the ridership using the following categories of transit payment methods:

- Prepaid – passes, tickets and transfers – and free rides;
- Cash

Table 7 presents this data. This data represents the prepaid share of the ridership, rather than the prepaid share of the revenue (i.e., the prepaid revenue share would be somewhat lower given the lower average fare for prepaid riders). On December 28, 2002, LYNX introduced a new fare structure that replaced calendar weekly period passes with activate-on-first-use 7 day period passes, and added a day pass. As one would expect, these new fare options have shown a tendency to increase the prepaid ridership share. This share was in transition during the before data collection period, so an overall percentage was not calculated for each route. Instead, a statistical analysis was performed for the data beginning from January 2003:

- Link 13: At the 95% confidence level, the average prepaid ridership share is expected to be 58% +/- 3% (i.e., between 57% and 60%, 95% of the time).
- Link 15: At the 95% confidence level, the average prepaid ridership share is expected to be 57% +/- 2% (i.e., between 56% and 58%, 95% of the time).

Table 7. Parking Prepaid Ridership Share Data

Route	Month	Prepaid	Cash	Total	Prepaid Ridership Share
Link 13	November	18,104	18,951	37,055	**49%**
	December	15,680	16,306	31,986	**49%**
	January	20,942	16,020	36,962	**57%**
	February	21,332	15,449	36,781	**58%**
	March	22,222	14,864	37,086	**60%**
Link 15	November	21,515	23,471	44,986	**48%**
	December	19,853	22,929	42,782	**46%**
	January	26,604	20,321	46,925	**57%**
	February	25,537	19,966	45,503	**56%**
	March	26,433	18,950	45,383	**58%**

3.3 Quantitative Goal 6 – Increase Automated Payment Equipment Uptime

Cash accepting equipment can suffer more downtime as the cash volume increases. This applies more to automated devices than to attended locations, since these devices use mechanical mechanisms to automate cash acceptance. By displacing cash use, the ORANGES card should reduce downtime. This would reduce maintenance costs and revenue loss (i.e., at unattended devices where revenue cannot be collected while the device is down).

Measure

- % operating hours with cash processing available (coins for toll Automatic Coin Machines (ACMs); coins and bills for fareboxes)

Test Hypothesis

- The frequency and severity of planned and unplanned maintenance for unattended devices relates to the amount of cash processed. Cash processing availability should increase as % prepaid increases.

Data Collection and Analysis

Tolls

OOCEA was able to provide data on the times when the various lanes at the Holland East toll plaza were down due to a failure attributed to "Automatic Coin Machines ((ACM) and tunnel vault" (see Table). ACM failures are

expected to be a frequent occurrence in this category. This data was provided for the entire months from November 2002 through March 2003.

Only lanes 4 and 5 (westbound) and lanes 10 and 11 (eastbound) are equipped with ACMs. The percentage availability calculation is based on the fact that these four lanes operate continuously. For the purposes of the evaluation, combining the data for the 5-month period enhances the overall value of the percentage availability. The statistical assessment for this 5-month sample indicates:

- At the 95% confidence level, the average ACM % availability is expected to be 99.38% +/- 0.37% (i.e., between 99.02% and 99.74%, 95% of the time).

Table 8. Toll Lanes Automated Coin Machine Uptime Data

Month	Downtime (DD:HH:MM)	Availability
November	00:18:09	**99.4%**
December	00:19:14	**99.4%**
January	00:12:35	**99.6%**
February	01:11:16	**98.7%**
March	00:07:30	**99.8%**
Combined	03:20:44	**99.4%**

Transit

LYNX was able to provide durations for the ten fareboxes that will be equipped for ORANGES acceptance for the entire months beginning November 2002 through March 2003 (see Table 9). The specific cause of the various farebox downtime incidents is not available from this data, although it is known that problems with the cash accepting components are a common cause of farebox incidents.

In this case, combining the data for the 5 months enhances the overall value of the percentage availability. These durations have been combined for the ten fareboxes. The statistical assessment for this 5-month sample indicates:

- At the 95% confidence level, the average farebox % availability is expected to be 99.12% +/- 0.19% (i.e., between 98.93% and 99.31%, 95% of the time).

Table 9. Transit Farebox Uptime Data

Month	Scheduled for Operation (DD:HH:MM)	Operational (DD:HH:MM)	Availability
November	180:10:45	179:7:51	**99.4%**
December	186:21:52	185:14:47	**99.3%**
January	185:21:13	183:23:02	**99.0%**
February	168:00:32	166:07:59	**99.0%**
March	186:21:43	184:19:48	**98.9%**
Combined	913:04:05	905:01:27	**99.1%**

3.4 Quantitative Goal 8 – Characterize Current Pass Distribution and Permit Billing Costs

LYNX uses prepaid fares extensively, issuing paper and magnetic stripe passes that are distributed through four sales outlets and by mail order. For the FOT, LYNX passes will be renewed directly on the smart card, at sales outlets or revaluing locations. Sales locations will need fewer paper passes, which should provide savings.

The ORANGES card may also replace the monthly "proximity" permit for garage parking. Currently, permit holders are billed monthly. Although this capability is not included in the initial deployment, a permit could be automatically renewed and the cost billed to a pre-registered credit card.

However, any reduction in the number of passes distributed will be limited during the test (and permits will continue to be billed using conventional methods). Characterizing the current costs for pass distribution and permit billing will indicate the magnitude of the potential cost savings if future deployment achieves bigger reductions. The specific cost categories and assumptions included have been documented for use in any such future consideration of this data.

This goal has not been applied to tolls, which already use a transponder and autoload.

Measure

- Costs for monthly billing of garage permits.
- Costs for distributing conventional weekly and monthly passes.

Data Collection and Analysis

Parking

The Parking Bureau assembled average monthly costs for processing monthly permit invoices. The Parking Bureau included in the cost:

- Salary/benefits cost for the accounting clerk performing this function;
- Postage costs for mailing the invoices.

Table 10 summarizes this data.

Table 10. Parking Permit Invoice Processing Costs

Accounting Clerk Salary/Benefits ($/hour)	$20.19
Average Accounting Clerk Time (Hours/month)	10
Average # Invoices Mailed per Month	335
Postage per Invoice	$0.37
Total Average Invoice Processing Cost ($/month)	$325.87
Average Monthly Cost per 1000 Invoices	**$972.76**

Transit

LYNX assembled monthly costs for processing monthly and weekly passes for the period between November 2002 and March 2003. The average number of passes processed per month was used to calculate the average cost per pass processed. LYNX included in this cost:

- Salary/benefits cost for the customer service staff that sell the passes ($14.24 per hour times a number of hours per month used for pass sales, based on the actual number of passes sold and an assumed average transaction time of 30 seconds per pass sold);
- Cost of the passes themselves (at a cost of $0.11 per pass);
- Salary/benefit cost for the accounting clerks in the money room that process passes for distribution ($17.03 per hour times a number of hours used per month for pass processing); and
- Commissions for pass sales on consignment.

Table 11 summarizes this data. In addition, to presenting the basis for the costs in each reported month, we have also established the results for the entire period combined.

Table 11. Transit Pass Processing Costs

Month	# of Passes Sold	Cost for Customer Service Staff	Cost for Pass Stock	Cost for Money Room Staff	Cost for Consignment Sales Commissions	Total Cost	Cost per 1000 Passes Sold
November	7,282	$864.13	$793.74	$885,56	$2,087.85	$3,745.72	**$514.38**
December	5,986	$710.34	$652.47	$885.56	$2,105.90	$4,354.27	**$727.41**
January	8,034	$953.37	$875.71	$885.56	$2,890.30	$5,604.94	**$697.65**
February	7,935	$941.62	$864.92	$1,021.80	$2,240.20	$5,068.54	**$638.76**
March	9,064	$1,075.59	$987.98	$1,021.80	$2,195.04	$5,280.41	**$582.57**
Combined	38,301	$4,545.05	$4,174.82	$3,814.72	$11,519.29	$24,053.88	**$628.02**

3.5 Quantitative Goal 9 – Characterize Current Processing Cost per Cash Transaction

ORANGES cards should decrease cash processing costs for transit, parking and tolls. However, many types of cash processing savings may not be achieved until card use is more widespread. Thus, the limited use of smart cards in the test may not achieve a significant cost savings in this area.

However, characterizing current cash processing costs will indicate potential cost savings if future deployment achieves bigger reductions in the use of cash. The specific cost categories and assumptions included have been documented for use in any such future consideration of this data.

Measure

- Costs for processing cash, for each mode.

Data Collection and Analysis

Parking

The Parking Bureau assembled costs for the period from October 2002 through March 2003 related to the cash processing costs at each garage. The types of costs the Parking Bureau included were:

- Salary/benefits costs for the gate cashiers and their supervisor that are assigned to that garage;
- A portion of the salary/benefits cost for the accounting clerk who counts the cash collected from all eight garages.

The cash revenue processed during this period was used to calculate the average cost per dollar of cash processed. Table 12 summarizes this data for the three equipped garages and for all three garages combined, with costs and revenues being the totals for this 6-month period.

Table 12. Parking Garage Cash Processing Costs

Garage	Cash Processed	Cost for Gate Cashier Staff	Cost for Money Counting Staff	Total Cost	Cost per $1000 Processed
Central Boulevard	$366,825	$123,000	$2,002	$125,002	**$340.77**
Market	$163,409	$114,000	$2,002	$116,002	**$709.89**
Library	$259,050	$100,000	$2,002	$102,002	**$393.75**
Combined	$789,284	$337,000	$6,002	$343,006	**$434.58**

Transit

LYNX assembled monthly costs for processing cash revenue for the period between November 2002 and March 2003. LYNX included in this cost:

- Salary/benefit cost for the accounting clerks in the money room that process cash revenue from both pass sales and fareboxes ($17.03 per hour times a number of hours used per month for cash processing); and
- Armored car charges to transport the pass sales cash from the sales location and farebox revenue from the garages to the money room location.

Table 13 summarizes this data. In addition, to presenting the basis for the costs in each reported month, we have also established the results for the entire period combined.

Table 13. Transit Pass Processing Costs

Month	Cash Processed	Cost for Money Room Staff	Armored Car Charges	Total Cost	Cost per $1000 Cash Revenue
November	$929,890.90	$10,013.64	$1,966.89	$11,980.53	**$12.88**
December	$892,892.47	$10,013.64	$1,966.89	$11,980.53	**$13.42**
January	$987,955.97	$10,013.64	$1,838.89	$11,852.53	**$12.00**
February	$969,269.47	$9,877.40	$1,838.89	$11,716.29	**$12.09**
March	$936,840.97	$9,877.40	$1,882.96	$11,760.36	**$12.55**
Combined	$4,716,849.78	$49,795.72	$9,494.52	$59,290.24	**$12.57**

Tolls

OOCEA decided not to release cash processing costs data, so this goal could not be evaluated for this agency.

4 Conclusion

LYNX, OOCEA and the Parking Bureau provided data from late 2002 and early 2003, corresponding to the specific goals and measures identified for this evaluation. OOCEA cash processing costs were the only instance where data planned for inclusion in the before data was not available. This time period was used as the before data analysis period, given the start of revenue service for the FOT was August 2003. The complementary documentation for the before data analysis summarizes the findings from the before discussion groups conducted with cardholders and employees in August 2003.

The remaining effort in Phase I will be to complete an overall assessment of the evaluation status as of the beginning of revenue service. Phase II will collect after data during the revenue service period, as identified in the evaluation plan. Acceptance test results should be collected early in the revenue service period. Weekly clearinghouse transaction reports should be collected throughout the revenue service period. Data for the other measures should be collected near the end of the revenue service period, and the after discussion groups should be conducted at that point as well.