E-ZPASS EVALUATION REPORT

Prepared for:
New York State Thruway Authority

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I. EXECUTIVE SUMMARY

The implementation of electronic toll collection equipment on the New York State Thruway occurred over a four-year period beginning in the 1993 and ending in 1997. In conjunction with implementation program, the Authority set a list of goals and objectives to be achieved through ETTM. These short- and long-term policy goals have been achieved, some expectations have been exceeded. The ETTM system has proven to be cost effective and the benefits to the Toll Authorities and customers have surpassed anticipated results.

The E-ZPass system has increased traffic throughput at toll plazas benefiting both the Toll Authority and customers in several ways. First, the Authority is able to process more transactions per hour, thereby increasing vehicle volumes processing. This increase eliminates the Toll Authorities' need to provide additional toll lanes to accommodate traffic volume growth translating to a capital cost savings. Second, the customer is able to travel through the toll plaza with little or no wait time. This not only decreases travel time for the customers with E-ZPass but also for customers without tags. Because there is less congestion at the toll plazas and more patrons are holding tags, cash and coin lanes have fewer vehicles.

The E-ZPass technology has proven compatible with existing NYSTA technology thereby facilitating the transition to coin-less operations for both customers and the Toll Authority. This translates into a capital cost savings for the Toll Authority. The Toll Authority avoided potential capital expenditures because they did not need to replace equipment to accommodate the introduction of new ETTM technology.

Customer satisfaction surveys distributed and analyzed by the NYSTA indicated a high approval rating for E-ZPass. Travel has become more convenient, tags are easy to install and billing has been primarily error and hassle-free. Survey respondents have indicated satisfaction with the customer service centers and customers have experienced perceptible savings in travel time.

The E-ZPass system has far exceeded initial expectations in terms of its compatibility and coordination with other area toll agencies. Original goals for multi-system coordination focused on the need for the E-ZPass to not interfere with technology at other toll facilities. The formation of the Inter Agency Group has resulted in a multi-agency system in which E-ZPass tags are both usable and readable at other toll facilities not only with the New York Metropolitan Area, but also throughout several northeastern states.

Policy, enforcement, institutional and legal issues for the E-ZPass system were initially technology driven. The possibilities and the limitations of E-ZPass technology originally set the

schedule and developed issues that needed resolution during the installation process. Eventually, the driver's seat changed. Policy and institutional issues began to compel the installation and coordination efforts. This was unexpected but occurred quickly once the acceptable technical solutions were identified. Now, policy solutions determined for E-ZPass are accepted as the industry standard. E-ZPass set the precedent.

Since, 1996, total E-ZPass tags in circulation has increased by over 240 percent to over 625,000 transponders. Tag distribution continues to increase. Multi-system coordination and tag compatibility was fostered by the formation of the Inter Agency Group. The IAG will result in continued increases in the tag circulation and eventually result in a fully integrated travel network throughout the United States.

II. INTRODUCTION

On August 2, 1993, the New York State Thruway Authority (NYSTA) implemented electronic toll collection at the Spring Valley Toll Barrier. Over the next three and a half years, the NYSTA installed electronic toll collection equipment throughout the corridor. By February 6, 1997 E-ZPass was installed on the entire Thruway system. E-ZPass provides patrons with nonstop passage through toll lanes. An illustration and descriptive text of how E-ZPass works is shown in Figure 1. A toll is collected by deducting the amount from a prepaid balance held on account with the *Thruway Authority*. Accounts may be established with certain credit cards, checks or cash. Initial account balances vary depending on the amount of tolls the customer plans to use in a month. This balance can be as low as $10.00 per month. When the account balance is down to a threshold amount (the replenishment threshold amount depends on the monthly amount of tolls and whether the account has automatic replenishment via a credit card or cash), the replenishment process occurs. Replenishment is either via a credit card or a bill is sent directly to the customer. The threshold amount is recalculated periodically.

This Study was initiated at the request of the Federal Highway Administration (FHWA) to evaluate the successes of the E-ZPass implementation program on the New York State Thruway. In addition, the FHWA requested that the analysis provide a description of lessons learned for use by other toll authorities in their implementation efforts. Because there is little quantitative data available prior to or during the implementation phase of E-ZPass on the Thruway, much of the analysis is qualitative and narrative.

This Study evaluates the E-ZPass policy and implementation experience and the inception of the Inter Agency Group for the New York State Thruway Authority. Original short and long term policy goals, marketing objectives and anticipated costs and benefits for E-ZPass implementation were reviewed. Based on discussion with the NYSTA, five analysis locations were selected. These are the Tappan Zee Bridge and Buffalo City Line Barriers and Interchanges 16 (Harriman), 24 (Albany) and 49 (Depew) of the Control System. Tolls on the controlled system are based on distance traveled with entry points and exit points. Tolls on the barrier system occur when a specific point is crossed (usually a bridge or tunnel).

Data was collected at these toll plazas for analysis of actual changes in traffic volumes, travel patterns and frequency of trip. The Study presents a comparison of anticipated and actual results associated with implementation of E-ZPass throughout the entire length of the New York State Thruway. Table 1 below presents the Implementation History of E-ZPass on the Thruway.

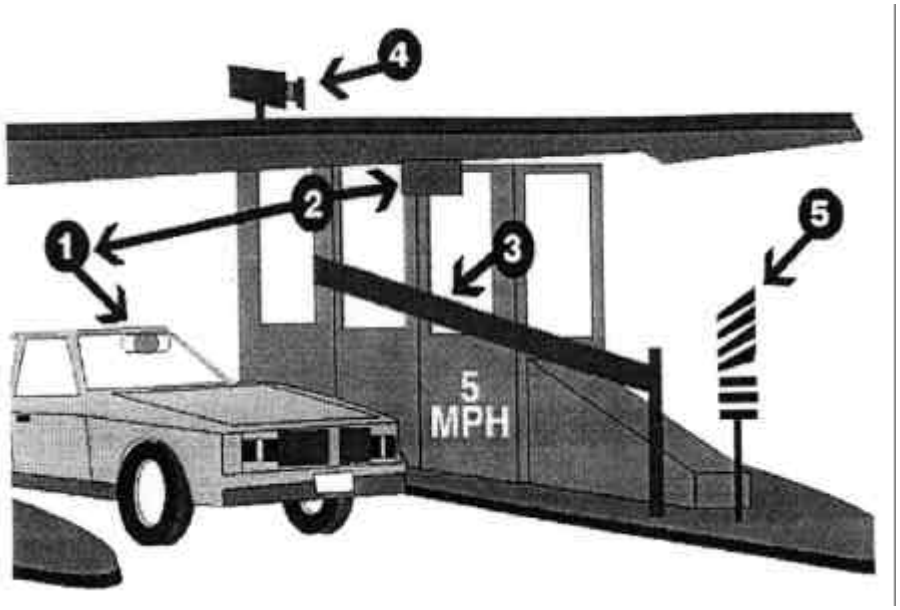


Figure 1
Illustration of E-ZPass Process

1. As you slowly pass through the toll lane, your E-ZPass tag is read.
2. Instantly, an antenna reads the tag and the proper toll is deducted from your prepaid E-ZPass account
3. At some facilities, there are gates that will go up when a valid tag is read.
4. A video enforcement system is in place to identify violators.
5. A traffic signal and message is immediately displayed to you just beyond the toll booth.

Source: NYSTA

Table 1
NYSTA ETC Implementation History

Interchange Control System	**Implementation Date**
Passenger Cars	
Albany to Amsterdam	April 17, 1995
Woodbury to Selkirk & Berkshire Section	June 19, 1996
Fultonville to Williamsville	December 4, 1996
Erie Section	February 6, 1997
Commercial Vehicles	February 6, 1997
Barriers	**Implementation**
Buffalo City Line	February 6, 1996
Black Rock	December 18, 1995
Grand Island Bridges (AMTECH)	October 26, 1993
Harriman (AMTECH)	June 6, 1994
New Rochelle	November 28, 1995
Spring Valley (AMTECH)	August 2, 1993
Tappan Zee Bridge (AMTECH)	August 30, 1993
Yonkers (AMTECH)	February 14, 1994
Other Important Dates	**Implementation**
Change from AMTECH to Mark IV E-Zpass	November 17, 1995
Trucks Not Permitted To Use Charge Plates	October 1, 1998
Removal of $1.00 Monthly Service Charge	July 1, 1996

III. IMPLEMENTATION GOALS AND OBJECTIVES

In the April 1991 *ETTM Needs Analysis Report* for the NYSTA, four major goals of ETTM implementation were defined. They are described below.

GOAL ONE: ETTM SHOULD INCREASE TRAFFIC THROUGHPUT WITHOUT EXPANDING PLAZAS

In 1991, several toll plazas on both the controlled system and individual barriers were experiencing severe peak hour traffic congestion. This occurred because traffic volumes entering each plaza exceeded the processing rate resulting in traffic queues. It was anticipated that queues would increase with traffic growth and require plaza expansion. ETTM was believed to be a means to increase total traffic throughput and decrease travel time through each plaza without expanding existing plazas.

GOAL TWO: THE SYSTEM MUST BE PLUG COMPATIBLE WITH THE EXISTING NYSTA BACK END

When the *1991 Needs Analysis Report* was prepared, the NYSTA was in the process of installing new equipment at all of its facilities. Another goal of ETTM was that it would operate in concert with the newly installed equipment and not require any modification or, in other words, it must be plug compatible.

GOAL THREE: ETTM SHOULD PROVIDE A MORE CONVENIENT METHOD OF TRAVEL FOR NEW YORK STATE THRUWAY AUTHORITY PATRONS

Ideally, ETTM was to provide the Thruway patron with non-stop toll collection requiring no direct interaction with toll plaza personnel. The tag was to be easily mountable and removable by the patron. In addition, tag accounts were to be established either by mail or in-person and payable by cash or check or automatically established through bank transfers or credit card debiting. In summary, a goal of ETTM was to provide a more convenient method of travel for NYSTA patrons.

GOAL FOUR: THE NYSTA ETTM SYSTEM SHOULD ATTAIN AN ACCEPTABLE LEVEL OF COORDINATION WITH OTHER AREA AGENCIES

Another goal of the ETTM system was that it had a level of compatibility with other area toll collection agencies. Ideally, the NYSTA tags were to be readable and usable on

other toll facilities but in the short term, the selected tag technology must not electronically interfere with that of the other agencies.

IV. POLICY GOALS AND OBJECTIVES

Policies were defined for both short and long term goals in the 1991 study. The period for short-term goals was determined to be April 1991 to 1996. Each policy issue is described below.

A. CONTROL SYSTEM VS. BARRIER SYSTEM

Short Term
The primary short-term focus of ETTM installation was barrier locations due to their capacity constraints. Initially it was not critical for the control system to be compatible with the barriers though heavier weighting was to be given to those technologies that would apply to both systems.

Long Term
The long-term goal for ETTM implementation was for one ETTM technology to be installed for both the Control and Barrier Systems. In addition, it should be functionally the same to the motorist. That is, the plaza traffic considerations, signage and other operational issues for the Control and Barrier systems would be similar to those of the existing system.

B. MARKETING ISSUES

Short Term
Class 1 (passenger cars) and non-revenue vehicles using script or cash for passage at barrier locations and commercial customers with charge accounts were to be first targeted for ETTM. In 1991, there was no consensus as to whether tags should be sold at a discount or with a surcharge. Customer response at toll plazas where ETTM was first installed would serve as a base for long term policy.

Long Term
The long-term market was expected to be all barrier customers and most likely permit/cash commuters and commercial account holders for the control system.

C. ACCEPTABLE LEVEL OF PATRON COMPLAINTS

Short and Long Term
A one- percent error rate in customer bills was considered acceptable. The acceptable availability of ETTM lanes in the plaza was not determined.

D. INTER AGENCY OR GO IT ALONE

Short Term
The selected technology was to be non-interfering with the system selected by the Inter Agency Group.

Long Term
Ideally, the NYSTA would have tag and reader compatibility with the Inter Agency Group, although this goal was assigned low priority.

E. BOND COVENANTS

Short Term
A credit-based system was in effect for commercial accounts, but it did require a bond to be posted and a minimum usage of the account. This method of payment was to be maintained for commercial accounts with ETTM although pre-payment was to be required by commuters. The only important requirement was that there be no net loss in revenues.

Long Term
After 1996, policy would depend on possible successor bond covenants, which should, in turn, consider implementation of ETTM technology. It was also desirable to maintain the payment policies outlined in the short term.

F. BILLING AND AUDIT

Short Term
In-house billing and audit was preferred as was setting up a system of automatic credit card debiting for customer accounts when balances fell below accepted minimums. A franchise would only be considered if an in-house system was not feasible.

Long Term
Long term billing and audit goals were similar to those set for the short term. However, the NYSTA would ultimately consider participating in an agency-wide central clearinghouse for payments since it might speed the availability of funds.

G. ENFORCEMENT

Short Term
At the time of the study, state legislation allowed violations to be issued to vehicle operators only if a human observed the violation. Photo enforcement and vehicle violations required legislation. A video enforcement system was to be installed to identify violators and discourage fraud. Selective enforcement would be performed based upon violation rates and spot checks.

Long Term
Long-term policy was to pursue legislation to allow photo enforcement and to alter the system of issuing violations.

H. LANE CONFIGURATIONS

Short Term
Dedicated ETTM lanes were to be considered at locations such as the Spring Valley and Tappan Zee Bridge toll barriers. For short-term policy, ETTM lanes would not necessarily operate as non-stop or E-ZPass dedicated lanes.

Long Term
Long-term policy was full implementation of dedicated non-stop lanes operating at 20-30 miles per hour based on safety considerations. The selected technology must have the ability to read tags at 65 miles per hour for traffic monitoring.

I. MULTIPLE VEHICLE TYPES - TAG TRANSFERABILITY

Short Term
Initially, only Class 1 and other passenger vehicles would be able to use ETTM tags. If all initial patrons were of the same vehicle class, tags would be transferable.

Long Term
All vehicle types would be able to use ETTM technology in the long term. The technology would need to handle multiple inputs based upon vehicle class in order to correctly determine the rate for that vehicle.

J. CONFLICT WITH DEPARTMENT OF MOTOR VEHICLES

Short and Long Term
At the time of the study, permits to place tags on cars' windshields required approval from the Commissioner of Motor Vehicles.

K. COMPATIBILITY WITH EXISTING BACK END EQUIPMENT

Short Term
Although very important, ETTM equipment compatibility with NYSTA equipment was not required during testing.

Long Term
The long-term policy was for plug compatibility.

L. TRANSPORTABILITY

Short Term and Long Term
Ultimately, it was expected that tags would be transportable by the customer from vehicle to vehicle as long as they were in the same vehicle class. The customer would also be able to disable a tag should he/she choose not to use it for a particular trip.

M. CONGESTION RELIEF

The Tappan Zee Corridor Congestion Relief Initiative was conceived after the 1991 study. Increased traffic during peak commuting hours exacerbated traffic congestion in the corridor. In addition, the completion of I-287 in 1993 created a beltway around New York City for travelers between New England and New Jersey. This beltway doubled the truck traffic at the Tappan Zee Bridge. Further, the Spring Valley toll barrier was viewed as an impediment to local Thruway use and a partial cause of traffic congestion on Route 59, the principal local east-west roadway in southern Rockland County, which runs parallel to a portion of the Thruway. The Initiative was designed to reduce congestion,

improve air quality, noise and safety, reduce truck traffic during peak periods and reduce traffic on Route 59.

The elements of the Initiative included the elimination of passenger car tolls at Spring Valley, the removal of southbound truck tolls at Spring Valley, a 50-cent increase in toll for non-commuting passenger car tolls at the Tappan Zee Bridge, the elimination of tolls for transit buses at both Spring Valley and the Tappan Zee Bridge and commercial vehicle congestion pricing.

In order to discourage truck traffic during peak periods, all commercial vehicles would pay up to double the toll during peak commuting times. The toll levels at the start of the peak period were gradually increased so that during the more congested hours, the tolls would be twice as much. As congestion decreases, tolls for those vehicles with E-ZPass are reduced back to pre-Initiative levels. The toll rate is doubled at all times for commercial cash payers, because a gradual toll change can not be effectively implemented and in order to encourage E-ZPass use.

V. INSTITUTIONAL AND LEGAL ISSUES

A. INITIAL PROJECT CONCEPTION

The evolution of this project from technology to policy driven occurred quickly in its execution. Many of the initial efforts evolved from finding acceptable technical solutions and products for electronic toll collection (ETC) equipment. Through a series of workshops with Authority staff, the policy issues identified earlier quickly began to drive the process. Many decisions required were driven not by technology but rather focused on defining and resolving the policies.

Some of the policy decisions are now accepted as common practice in the development of new systems at other facilities. Several issues were of particular importance in this process. Two among these, the realization of toll patrons becoming customers and the value of working with other agencies will be briefly discussed.

Historically toll roads had patrons who used the facility and passed cash to a toll collector. Typically they had no name and no on-going relationship with the Authority other than when they passed a toll facility. There were some exceptions to this such as permits, commuter tickets and the commercial charge program. With ETC, those patrons

that chose to use transponders became customers. The Thruway had to establish an account and manage the funds of thousands of individuals. They had to provide "customer service" and be prepared to respond to telephone inquires regarding ETC activity. For example, without ETC, a jammed coin machine may have produced a friendly wave by a nearby toll collector to pass though the toll lane. With ETC, a failed reader may have produce a violation notice to an unsuspecting customer. The latter case with ETC then generated development of policy and technology that would greatly limit or eliminate those actions as a function of customer service. Therefore, the "customer" had significant influence on the development of the entire ETC program at the Thruway.

In the early phases of the Implementation Study, little effort was made regarding interoperability with other toll agencies. In fact, this point is apparent in the original long term policy statement regarding this issue giving it a "low priority". At the outset of the effort, interoperability, received even less attention. However, as the process evolved it became apparent that there was value in interoperability. It provided both economies of scale in the procurement of the basic equipment and higher levels of "customer service" to the Thruway users. Interestingly, out of this process, the concept of the customer was raised to higher levels of awareness. Ultimately, the Thruway became a leader in the development of the E-ZPass Inter Agency Group. As can be seen in the E-ZPass usage statistics, this cooperation with other regional agencies has provided operating benefits to the Thruway with no additional capital investment and also has provided travel benefits to their own E-ZPass customers traveling on other IAG facilities.

B. INTER AGENCY GROUP

One of the original goals of the program was to "attain an acceptable level of coordination with other agencies". As the program has evolved this has been achieved in numerous ways. Foremost among them is the evolution of the E-ZPass Inter Agency Group or IAG. This collaborative group originated with seven members in 1991 and most recently numbers 13 different toll agencies. They cover a geographic area ranging from West Virginia in the south and west to New York in the north and Massachusetts in the east.

The goal of the IAG was to adopt a single transponder technology for all travelers and ultimately achieve a single account for each user. The former proved much easier to achieve than the latter with the common Mark IV transponder technology being quickly adopted. The IAG issued an RFP for a single common clearinghouse that did not prove successful for a variety of reasons. In its place, the member agencies established

individual customer service centers and adopted the concept of reciprocity for collecting toll revenues from other IAG members. This lead to the creation of several larger clearinghouses, one of which is a common facility for the Thruway and MTA Bridges and Tunnels.

Reciprocity introduced many issues to the Thruway Authority. A requirement of E-ZPass is that any valid transponder can be used on any member agency's toll facilities. This requirement resulted in agencies, such as the Thruway Authority, guaranteeing toll payments for their customers' travel with valid toll accounts on other IAG member facilities. Guaranteeing toll payments was relatively easily established for passenger cars, which had a limited toll exposure and easily collectable funds through prepaid credit card accounts. Guaranteeing toll payment for commercial accounts proved to be more problematic.

The Thruway Authority maintains a post paid commercial charge program. That is, commercial customers are billed for travel after it occurs. This program required the posting of a bond to cover any revenues, which became uncollectible for insolvent commercial accounts. A single commercial account can have several hundred transponders assigned to it. Therefore, E-ZPass required the "guaranteeing" of potential toll travel by several hundred vehicles on numerous other toll facilities. Reciprocity introduced a toll exposure that could be substantial for commercial accounts. These exposures included toll revenues and the segregation of non-Thruway tolls from the volume discount program. Alternatives to mitigate the risks were introduced.

Alternatives included companion and pre/post paid accounts. An early approach to limiting this exposure was the companion account, which required the establishment of a valid toll account at each IAG agency for particular transponders. Each agency had the right to not designate the tag status as valid leaving each agency with the need to identify an away tag number as a companion account of their own. The companion account also allowed commercial operators to take advantage of volume discounts at several facilities. For example, a Thruway E-ZPass customer could open an account on the Thruway for travel on the Thruway and using the same transponder open a "companion account" with the MTA Bridges and Tunnels. Travel on each facility would then be billed through each facility independently.

An alternative to the companion account was later introduced. This was the pre/post paid account. Commercial post-paid Thruway account holders could maintain their post-paid Thruway account and attach to it a separate pre-paid account for travel on other facilities.

This is closer to the original concept of one account and one tag and is in fact a model that is being followed by other member agencies as the come on-line with E-ZPass.

The IAG is one of the most successful aspects of the Thruway's E-ZPass program. It has both improved customer service for regular Thruway patrons and enhanced the travel of other less frequent users of the facility. Many of the throughput and operational improvements have come about with the "help" of the non-Thruway E-ZPass holders. It was estimated in 1998 that non-Thruway E-ZPass holders make 28 percent of all E-ZPass trips at the Tappan Zee Bridge. Similar results were seen as commercial E-ZPass use was introduced. In general the benefits of this program will only expand with the expansion of E-ZPass.

C. TECHNOLOGY SHARING

The adoption of the Mark IV transponder technologies was one of the first successes of the IAG. However, it did not come about easily. The group recognized the benefits of sharing technology in the adoption of a single technology for their facilities. The strength of the IAG was fully realized during the procurement and testing phase.

After the field of transponder proponents was narrowed to two, an extensive testing process was conducted. In what was arguably the most extensive test of AVI equipment ever conducted, the two finalists went through two periods of extensive testing. The second corrected some deficiencies in both vendors' products that were uncovered in the initial test. At the end of the testing program, both vendors demonstrated that the statistical accuracy of their systems were in excess of 99.95 percent. The results assured the agencies that the selected transponder technology would work to their desired specifications.

The subsequent volume of transponders delivered to the IAG now exceeds 3 million and continues to grow as new member agencies take advantage of the lessons learned by the IAG and the economies of scale of a growing E-ZPass toll road network. Like reciprocity, this is another example of progress made in technology sharing and interagency cooperation.

D. ENFORCEMENT

1. Generic Legislation vs. Specific Legislation

No formal state legislation was prepared at the inception of E-ZPass to mandate the process for issuing tickets and collecting fees from E-ZPass toll violators. In the past, with manual lanes and coin machines, violators were identified by toll collectors and by coin machine alarms. With the advent of ETC technology, more efficient means of identifying and issuing penalties to violators were developed.

In May 1995, Senator Levy introduced legislation to the New York State Senate on behalf of the New York State Thruway Authority to empower the Authority to issue summonses and collect fees and penalties for toll violations.

Presently, in New York State, the process for identifying toll violators (including tag holders, those with no-tags driving through the E-ZPass lane, and speeders) is as follows: when a driver violates the toll plaza regulations, the photo monitoring system (videotape, photograph) records their license plate. This information is passed via computer to the customer service center. If the violator is an E-ZPass holder, the toll authority issues a violation directly to the customer. If the violator is not an E-ZPass holder, the toll authority sends a copy of the violators' license plate to the Department of Motor Vehicles to identify the name and address of the violator. Once they have the name and address of the violator, the toll authority issues a violation directly to them.

The relevant sections of the legislation are included below:

S. 2985

1. "EVERY PUBLIC AUTHORITY WHICH OPERATES A TOLL HIGHWAY BRIDGE, AND/OR TUNNEL FACILITY IS HEREBY AUTHORIZED AND EMPOWERED TO IMPOSE MONETARY LIABILITY ON THE OWNER OF A VEHICLE FOR FAILURE OF AN OPERATOR THEREOF TO COMPLY WITH THE TOLL COLLECTION REGULATIONS OF SUCH PUBLIC AUTHORITY IN ACCORDANCE WITH THE PROVISIONS OF THIS SECTION."

The relationship established between the New York State Thruway Authority and the Department of Motor Vehicles is perhaps the most significant aspect of the legislation. The photo monitoring systems will automatically record license plate information for toll violators and electronically issue tickets via mail only if the

violator is a current E-ZPass tagholder. If not, the Department of Motor Vehicles will issue information to the toll authority regarding the name and address of the violator. It is this element which removes the anonymity from the process and is subject to wide debate.

The issue of photographing or videotaping the license plates of violators is also sensitive. The notion that the toll authority can track the whereabouts of drivers based on their tag usage patterns may be viewed by some as an invasion of privacy. As the passage below indicates, not only would the tickets be issued electronically, but also these photographs or other representations of toll violation could be admissible in court as evidence.

2. " THE OWNER OF A VEHICLE SHALL BE LIABLE FOR A CIVIL PENALTY IMPOSED PURSUANT TO THIS SECTION.... IN VIOLATION OF TOLL COLLECTION REGULATIONS, AND SUCH VIOLATION IS EVIDENCED BY INFORMATION OBTAINED FROM A **PHOTO-MONITORING SYSTEM**...."

4. A CERTIFICATE, SWORN TO OR AFFIRMED BY AN AGENT OF THE PUBLIC AUTHORITY WHICH CHARGED THE VIOLATION OCCURRED, OR A FACSIMILE THEREOF, BASED UPON INSPECTION OF PHOTOGRAPHS, MICROPHOTOGRAPHS, VIDEOTAPE OR OTHER RECORDED IMAGES PRODUCED BY A PHOTO MONITORING SYSTEM SHALL BE PRIMA FACIE EVIDENCE OF THE FACTS CONTAINED THEREIN AND SHALL BE ADMISSIBLE IN ANY PROCEEDING CHARGING A VIOLATION OR TOLL COLLECTION REGULATIONS. ANY PHOTOGRAPHS, MICROPHOTOGRAPHS, VIDEOTAPE OR OTHER RECORDED IMAGES EVIDENCING SUCH A VIOLATION SHALL BE AVAILABLE FOR INSPECTION IN ANY PROCEEDING TO ADJUDICATE THE LIABILITY FOR SUCH VIOLATION.

Means have been incorporated in this legislation to minimize the threat of invasion of privacy. This is because the public perception is that much of the E-ZPass enforcement policy is based on the premise that the toll authority has the ability to track movement and record license plate information of toll road users. The Toll Authority can also access identity and address information on violators through their relationship with the Department of Motor Vehicles. This can be viewed as invasive and threatening. However, the legislation also notes that information collected through videotaping or photo monitoring will remain the sole property of the toll authority and can not be used in conjunction with any other legal proceedings. This clause insures toll road users that their travel

behavior and whereabouts will not be tracked and information will not be used unless the user is in violation of traffic or toll plaza regulations.

2. Statewide (Department of Motor Vehicles) Enforcement

6. .... AN IMPOSITION OF LIABILITY PURSUANT TO THIS SECTION SHALL NOT BE DEEMED A CONVICTION AS AN OPERATOR AND SHALL NOT BE MADE PART OF THE MOTOR VEHICLES OPERATING RECORD, FURNISHED PURSUANT TO SECTION THREE HUNDRED AND FIFTY-FOUR OF THE VEHICLE AND TRAFFIC LAW, OF THE PERSON UPON WHOM SUCH LIABILITY IS IMPOSED NOR SHALL IT BE USED FOR INSURANCE PURPOSES IN THE PROVISION OF MOTOR VEHICLE INSURANCE COVERAGE.

As noted above, if a current E-ZPass tagholder violates NYSTA toll collection regulations or speed limits, a ticket is issued directly to the violator from the NYSTA through the Customer Service Center. If a violator does not hold an E-ZPass tag, the photo of their license plate is forwarded to the Department of Motor Vehicles and the DMV sends back to the E-ZPass Customer Service Center the name and address of the violator.

A notice of violation is sent via first class mail to the violator. The notice includes the name and address of the vehicle owner, the registration number of the vehicle, the location, date and time of the violation, and the identification number of the photo monitoring system. This information, including photographs, is entirely admissible in court for prosecution of the toll violation incident. It is not, however, admissible in court for any other purposes. A provision is included in the enabling legislation prohibiting the use of all recorded materials used in conjunction with the process of identifying violations for any other purposed in court. All materials do remain the exclusive property of the toll authority. This is a particularly crucial element of the legislation in that it eliminates the concern that electronic toll collection carries with it a “big brother” element.

VI. USER ACCEPTANCE

A. PAYMENT METHODOLOGY

Electronic toll collection was first implemented on New York Metropolitan Transit Authority (NYCMTA) Bridges and Tunnels Division facilities in October 1995 and at

Port Authority of New York and New Jersey (PANYNJ) facilities in July 1997. Since both the NYCMTA and the PANYNJ have installed E-ZPass at all of their toll plazas, patrons with E-ZPass tags from these agencies have made a considerable impact on NYSTA facilities as well. This impact is most apparent on the Tappan Zee Bridge and on the Control System.

Figure 2 shows the impact of NYCMTA and PANYNJ accounts on the NYSTA Control System. For the twelve-month period ending March 1999, the E-ZPass trips constituted 29 percent of all trips. Of these, patrons with NYCMTA (8 percent) and PANYNJ (1 percent) accounts made 9 percent. These amounted to almost 3.5 million trips. Considering that a transponder costs $20 and the operating costs of maintaining each account, these non-Thruway E-ZPass account holders result in significant costs savings for the NYSTA. Figure 3 illustrates the impact of NYCMTA and PANYNJ accounts on the Tappan Zee Bridge. From March 1998 through March 1999, the average market share was 54 percent.

Figure 2
12-Month Average E-ZPass Vehicle Trips on Control System

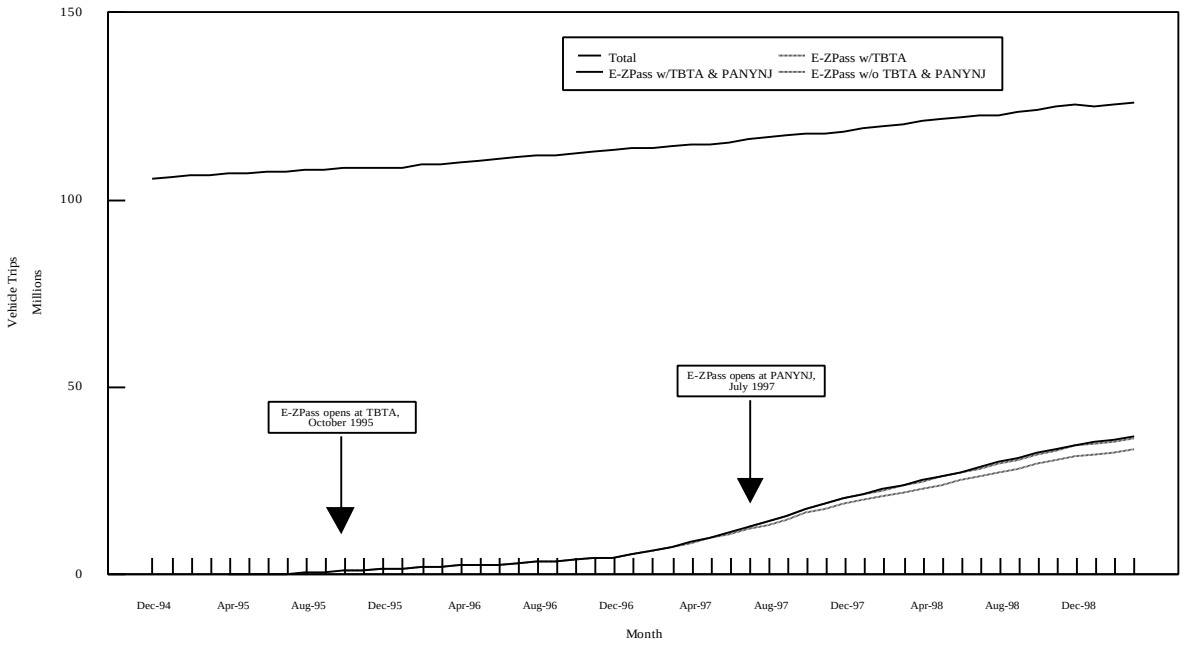
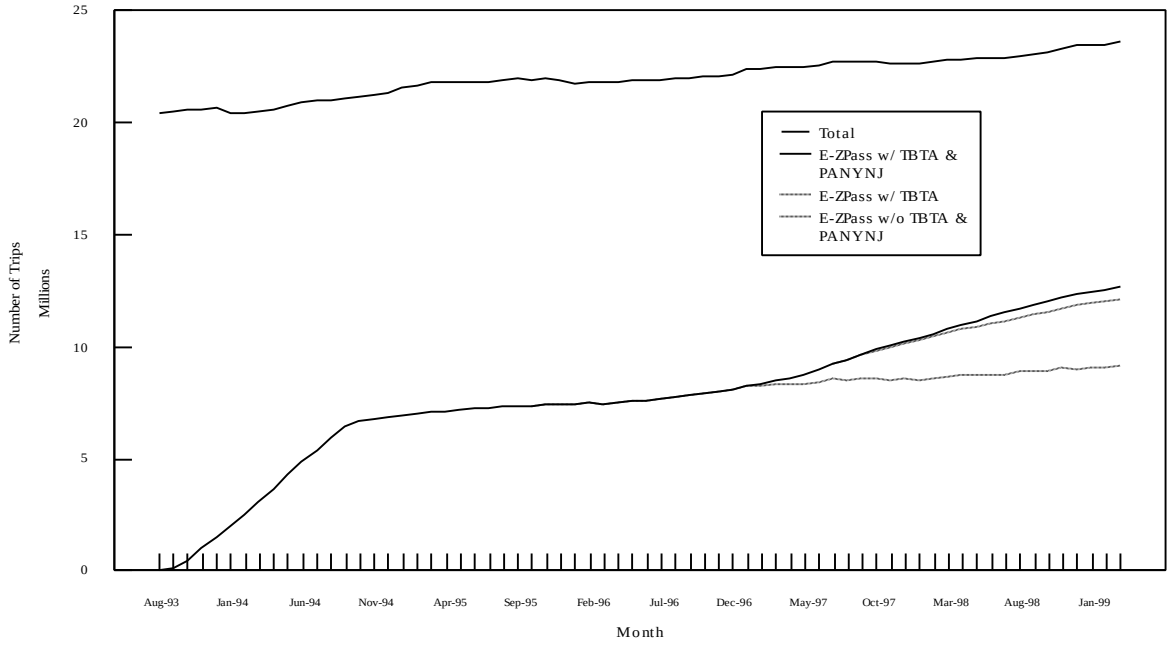


Figure 3
12-Month Average E-ZPass Vehicle Trips on TZB



Between the winter of 1994 and March 1999, the E-ZPass market share has slowly increased (if the effects of NYCMTA and PANYNJ accounts are not considered). It appears that the market of NYSTA accounts may be leveling off. From February 1997, however, total E-ZPass market share has grown significantly. Of total Thruway E-ZPass trips, 28 percent were made by NYCMTA (24 percent) and PANYNJ (4 percent) account holders. These trips totaled over 3.5 million trips and as discussed for the Control System, there have been considerable cost savings in transponder fees and account maintenance for the NYSTA.

B. MARKET SHARE AND FREQUENCY OF USE

1. Peak and Off-Peak Hour Penetration

Hourly data was obtained for a week starting December 1, 1998 for the Buffalo City Line, the Tappan Zee Bridge and Interchanges 16, 24 and 49 on the Control System. E-ZPass market share was determined from this data for both peak and off-peak periods and compared to average annual E-ZPass usage for the twelve months ending March 1999 as summarized in Table 2. Average annual E-ZPass usage at individual interchanges on the Control System was not available and the hourly data for the analyzed interchanges was compared to data for the entire Control System.

For the week starting December 1, 1998, the market share at the Tappan Zee Bridge, Buffalo City Line and Control System averaged 54 percent, 24 percent, and 29 percent, respectively. Market share at the barriers ranged as much as 31 percent from the maximum peak period to minimum off-peak period market share at the Tappan Zee Bridge Barrier and as little as 18 percent for the same periods at the Buffalo City Line Barrier. For the Control System, the three individual interchanges analyzed ranged from 20 percent to 25 percent between maximum peak and minimum off-peak period E-ZPass market share.

Table 2
E-ZPass Off-Peak and Peak Period Market Share

	E-ZPass Market Share		
		December 1 - 7, 1998	
	March 98 - March 99	Peak Hour Maximum Market Share	Off-Peak Hour Minimum Market Share
Barriers			
Tappan Zee Bridge	54%	76%	45%
Buffalo City Line	24%	37%	19%
Control System			
Entire System	29%	N/A	N/A
Interchange 16 (Harriman)	35%	54%	29%
Interchange 24 (Albany)	43%	48%	28%
Interchange 49 (Depew)	33%	50%	25%

2. Market Share and Total Tags in Circulation

Since August 1993, as more facilities implemented E-ZPass and other toll agencies installed ETC equipment, market share steadily increased. During the same period, the total number of tags issued by the NYSTA increased significantly. Figure 4 shows the total tags in circulation and E-ZPass Market Share indexed to February 1994. Since November 1996, the rate of growth of total tags in circulation has increased at a significantly higher rate than the growth rate of E-ZPass transactions. Figure 5 which shows passenger car frequency of use on the Control System by trips and individuals illustrates the change in growth between total tags and E-ZPass market share. The first patrons to get E-ZPass are those who use Thruway facilities the most often. Those who travel more than once a week, about 45 % on the Control System, make up less than 10% of all passenger car trips on that facility. By early 1997, mostly infrequent Thruway users were starting new accounts, which is why the market share growth does not match that of the total tags in circulation. The market share growth would in fact be less if it weren't for new NYCMTA and PANYNJ accounts.

Figure 4

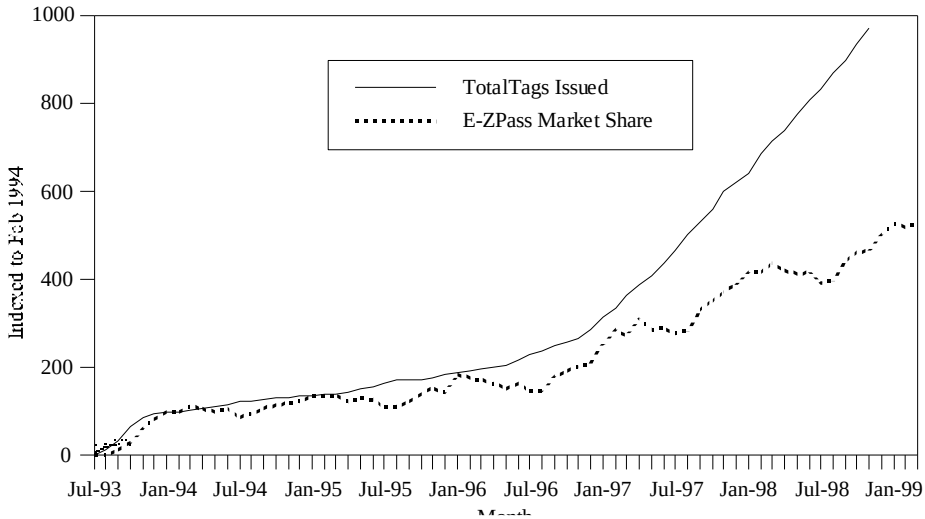
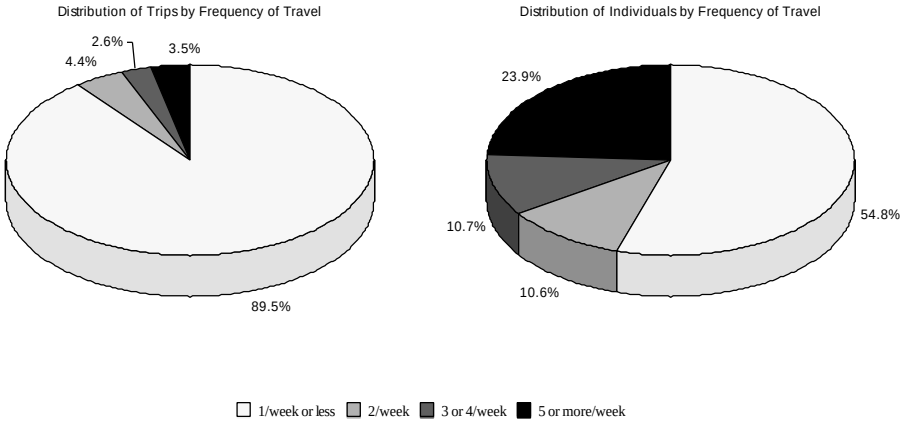


Figure 5
Frequency of Travel



Source : December 1996 NYSTA Report on Frequency of Use Survey

C. MARKETING PROGRAM

1. Predicted vs. Actual Preferences

A Study of Commuter Preferences for the Implementation of E-ZPass on New York State Thruway Authority Facilities was prepared by Marketing Metric, Inc. in September 1993 in order to determine how best to market electronic toll collection in the area. Over 3,300 commuters who use the NYSTA, Port Authority of New York and New Jersey, Triborough Bridge and Tunnel Authority, New Jersey Highway Authority and New Jersey Turnpike Authority toll facilities were surveyed about their likelihood of enrolling in the E-ZPass system. Each participant received a survey package by mail and was then contacted by telephone in order to complete an in-depth personal interview.

The survey revealed that given the NYSTA most probable configuration, 18 percent of the Tappan Zee Bridge non-discount customers, 15 percent of the Tappan Zee Bridge discount customers and 15 percent of the Control System patrons would be most likely to subscribe to the E-ZPass program. The most likely configuration included the following features:

1) Single account to cover all NY/NJ toll agencies;
2) Customer motivated payment at a specified time by check through the mail;
3) E-ZPass dedicated and non-dedicated lanes;
4) Non-transferable tag;
5) One-time charge of $10 plus a $1.50 additional charge per month;
6) Current commuter discount with a monthly prepayment method and
7) No other uses for E-ZPass.

This configuration differs from the existing E-ZPass service in that there are no fees for using E-ZPass and payment can be made by check, cash or credit card either in person or through the mail.

Another question asked of the survey participants was how many toll facilities the individual passed through. For the Control System patrons, Tappan Zee Bridge cash patrons and Tappan Zee Bridge commuters the average number of facilities used averaged 2.8, 2.3 and 2.5, respectively. For users on the Control System, between 38 percent and 47 percent also traveled on the George Washington Bridge, Tappan Zee Bridge, Garden State Parkway and/or New Jersey Turnpike during the two weeks prior to the survey. For Tappan Zee Bridge cash patrons, between 22 percent and 48 percent also traveled on the George Washington Bridge, Garden State Parkway, New Jersey Turnpike, and/or Lincoln Tunnel during the two weeks prior to the survey. For Tappan Zee Bridge commuters, between 21 percent and 52 percent also traveled on the

George Washington Bridge, Garden State Parkway, NYSTA Control System and/or New Jersey Turnpike and Lincoln Tunnel during the two weeks prior to the survey. These figures gave some indication of how many patrons of the Thruway facilities might obtain a tag from another toll agency or use a Thruway tag on another facility.

2. Marketing Program

The initial marketing program executed by the NYSTA in relationship to E-ZPass can best be described as informational. The first users of E-ZPass were passenger cars and commuter ticket users at the Tappan Zee Bridge. As such, E-ZPass was marketed as a replacement to the ticket program and later the permit program on the main line of the Thruway. Similarly, E-ZPass was a replacement of the commercial charge card program. As such, much of the early marketing was directed towards existing users of the various Thruway charge and discount programs. Other initiatives included the placement of E-ZPass information and applications at Thruway service areas and informational signs along the Thruway right-of-way giving 800 telephone number information about E-ZPass. In summary the program can be considered successful in the transition from the old programs to E-ZPass and the increased number of E-ZPass participants over the previous programs.

3. Public Reaction to EZ Pass

The New York State Thruway Authority conducted a customer satisfaction survey in the spring of 2000. Two different survey cards were distributed - to cash paying patrons at selected toll plazas and to NYSTA patrons with E-ZPass. Of the total 18,000 survey cards distributed, 4,494 (23%) were returned.

NYSTA Patrons With E-ZPass

A survey was mailed randomly to 10,000 E-ZPass patrons with their monthly statement. Almost 39 percent of the surveys were returned. The survey included several questions including:

- How did you first became aware of E-ZPass?
- What benefit did E-ZPass provide?
- Did Thruway usage increase with E-ZPass?
- What was your experience with customer service?
- How accurate are your E-ZPass statements?
- What was your experience with dedicated E-ZPass lanes?

- What was your method of payment prior to E-ZPass?
- Which lanes do you prefer?
- What is your age, gender and household income?

The results as summarized by the Thruway are presented in Table 3. Most patrons first became aware of E-ZPass through advertising at the toll plaza (62%). The primary reason for applying for E-ZPass was that it would save time at the toll plaza (73%). Over 70 percent of those surveyed did not increase their use on the Thruway or other toll facilities subsequent to E-ZPass installation. Prior to E-ZPass, 50 percent of patrons used both coined and staffed lanes. Most (64%) would not prefer to obtain E-ZPass account information through the Internet. The majority of respondents (55%) was over 50, male (69%) and had a household income over $75,000 (66%).

In general, the results showed overwhelming customer satisfaction with the E-ZPass program. Over 93 percent agree that it was easy to open an E-ZPass account and almost 78 percent felt that their experience with the Customer Service Center has been positive. Close to 89 percent agreed that their E-ZPass statements are accurate. Over 95 percent believed that E-ZPass has made it easier to pay tolls and dedicated E-ZPass lanes help move traffic better. More than 50 percent felt E-ZPass saved them time the morning and afternoon rush hours, midday and weekend. Only 24 percent believed E-ZPass saved them time during the late night period. Overall, over 97 percent had a favorable opinion of E-ZPass including 65 percent which found it very favorable.

Cash Paying NYSTA Patrons

A separate survey card was given to 8,000 cash-paying New York State Thruway users in the Buffalo, Syracuse, Albany and New York areas (at select toll plazas. Of these, 160 (2%) were returned. Questions included:

- Do you have E-ZPass?
- Do you know what E-ZPass is?
- What are your first impressions of E-ZPass?
- Will you open an E-ZPass account in the future?

The results were summarized by the NYSTA and shown in Table 4. Almost 87 percent did not have E-ZPass while almost all knew (98%) what E-ZPass is. More than 87 percent at least somewhat approved of E-ZPass though 52 percent would not open an E-ZPass account. Almost 64 percent would not open an account over the Internet. Ranked in order of importance, rated

highest was saving money with E-ZPass, followed by saving time, then ease of maintaining an E-ZPass account and finally ease of obtaining an account. Most of the respondents (59%) were male, between the age of 25 and 50 (37%), had a household income between $25,000 and $50,000 (37%) and received the questionnaire in Syracuse (68%).

Table 3
NYSTA E-ZPass Patron Survey
Summary of Results

Question 1: How did you become aware of E-ZPass?										
Advertisement at Toll Plaza	61.7%	Newspaper	23.8%	Word of Mouth	19.3%	Brochure	16.8%	TV/Radio	12.2%	Other	0.0%
Question 2: Why did you apply for an E-ZPass tag? (1=most important)										
		Rated 1		Rated 2		Rated 3		Rated 4		Rated 5
a) Save time at Toll Plazas		73.0%		22.6%		2.8%		0.7%		0.8%
b) Convenience of not using cash		16.5%		67.0%		13.4%		2.1%		1.1%
c) Statements provide payment records		0.5%		4.3%		51.1%		34.0%		10.2%
d) Like new technology		1.1%		4.6%		27.4%		51.9%		15.0%
e) Other		28.2%		6.8%		11.2%		5.4%		48.4%
Question 3: Now that I have E-ZPass, I have increased my use of the New York State Thruway?										
Yes		21.4%				No		78.6%		
Question 4: Now that I have E-ZPass, I have increased my use of other toll/bridges and tunnels?										
Yes		29.4%				No		70.6%		
Question 5: It was easy to open the E-ZPass account.										
Strongly Agree	41.3%	Agree	52.2%	No Opinion		2.1%	Disagree	3.0%	Strongly Disagree	1.4%
Question 6: My experience with the E-ZPass Customer Service Center has been positive.										
Strongly Agree	24.9%	Agree	52.6%	No Opinion		4.1%	Disagree	11.4%	Strongly Disagree	7.1%
Question 7: My E-ZPass statements are accurate										
Strongly Agree	34.9%	Agree	53.9%	No Opinion		3.4%	Disagree	5.5%	Strongly Disagree	2.3%
Question 8: E-ZPass has made it easier for me to pay tolls.										
Strongly Agree	72.3%	Agree	25.5%	No Opinion		1.0%	Disagree	0.6%	Strongly Disagree	0.6%
Question 9: I feel that "E-ZPass Only" lanes help move traffic better.										
Strongly Agree	66.8%	Agree	29.2%	No Opinion		0.4%	Disagree	2.7%	Strongly Disagree	0.8%
Question 10: E-ZPass saves me time during the following periods.										
Morning Rush Hour	76.3%	Midday	63.1%	Evening Rush Hour	59.8%	Late Night	23.5%	Weekend	57.2%	No Opinion	5.3%
Question 11: Before I had E-ZPass, I generally used……										
Both (coin/ staffed lanes)	50.0%			Exact change lanes (coin baskets)		25.6%		Staffed lanes (toll collector)		24.4%
Question 12: When I use E-ZPass, I generally use……										
Dedicated "E-ZPass Only" lane		94.9%		Staffed lane with E-ZPass available			1.6%	No Preference		3.6%
Question 13: Would you prefer to obtain E-ZPass account information using a website?										
Yes		36.2%				No		63.8%		
Question 14: My general impression of E-ZPass is……										
Very Favorable	65.0%	Favorable	32.5%	No Opinion		0.6%	Not Favorable	1.1%	Very Unfavorable	0.8%
Question 15: What is your age?										
Less than 25		0.1%		25-50		44.5%		Greater than 50		55.4%
Question 16: What is your gender?										
Male				68.6%		Female			31.4%	
Question 17: My total annual family income before taxes is……										
Less than $25,000	2.1%	$25,001-$50,000		10.6%		$50,000-$75,000		20.9%	Over $75,000	66.4%

Table 4
NYSTA Cash Paying Patron Survey
Summary of Results

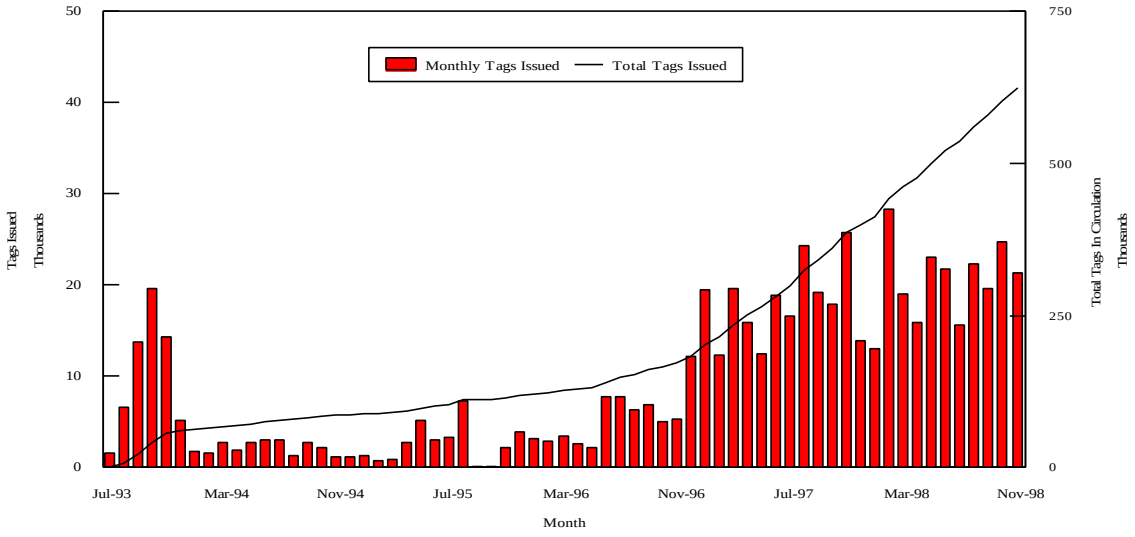
Question 1: Do you have E-ZPass?							
Yes		13.2%	No		86.8%	No Answer	0.0%
Question 2: Do you know what E-ZPass is?							
Yes		98.1%	No		1.9%	No Answer	0.0%
Question 3: Your first impression of E-ZPass.							
Approve	67.1%	Somewhat Approve	20.1%	Somewhat Disapprove	3.4%	Disapprove	9.4%
Question 4: Will you open an E-ZPass account?							
Yes		48.0%	No		52.0%	No Answer	0.0%
Question 5: Would you open an account using a web site?							
Yes		36.1%	No		63.9%	No Answer	0.0%
Question 6: Please consider these E-Zpass issues and rank them in order of importance to you (1=most important)							
			Most Important	2nd Most Important	2nd Least Important	Least Important	No Answer
a) Will I save money with E-ZPass?			47.5%	26.2%	9.2%	17.0%	0.0%
b) Will I save time using E-ZPass?			37.1%	34.3%	14.3%	14.3%	0.0%
c) Is it easy to obtain an E-ZPass?			8.0%	15.9%	39.1%	37.0%	0.0%
d) Is it easy to maintain an E-ZPass account?			8.7%	21.7%	36.2%	33.3%	0.0%
Question 7: Your Gender?							
Male		58.6%		Female		41.4%	
Question 8: Your Age?							
Less than 25		11.3%	25-50	57.9%	Greater than 50		30.8%
Question 9: Household Income before taxes?							
Less than $25,000	9.9%	$25,001-$50,000	36.8%	$50,000-$75,000	29.6%	Over $75,000	23.7%
Question 10: Division							
Syracuse (green)	68.4%	New York (yellow)	19.0%	Albany (blue)	7.6%	Buffalo (White)	5.1%

4. Frequency of Tag Distribution

Historical data was obtained on the number of monthly transponders issued by the NYSTA. Figure 6 shows the monthly tags issued and total number of tags in

circulation through November 1998. When ETC was first introduced over a three-month period at three interchanges there, was a significant increase in the number of transponders issued per month. From January 1993 through December 1996 there was a 37 percent increase to almost 185,000 total tags issued as the ETC equipment was installed at the remaining barriers and part of the Control System. During September and October 1995, all existing transponders, manufactured by AMTECH, were collected and replaced with Mark IV tags. In December 1996 the NYSTA implemented E-ZPass for passenger cars for a large section of the Control System and by February 1997, all bridges and barriers could process ETC transactions for all vehicles. From February 1997 through November 1998, the number of monthly tags issued and consequently the total number of tags in circulation has grown considerably. Since December 1996, the total tags in circulation have increased by over 240 percent to over 625,000 transponders. While the rate of increase has decreased for the first 11 months of 1998 over the same period in 1997, the total number of tags is still increasing. As shown in Figure 3, however, the market share of NYSTA accounts is starting to level off and not matching the growth of total tags in circulation. As discussed previously, this is because new E-ZPass account holders travel less frequently.

Figure 6
Tags Issued by NYSTA



VII. SYSTEM BENEFITS

A. PLAZA THROUGHPUT

The potential effect the implementation of E-ZPass has on peak hour toll plaza throughput was also analyzed. In conjunction with the April 1991 *ETTM Needs Analysis Report*, a survey was conducted for a week in October 1990 in order to evaluate which sections of the Thruway were problem areas. The plazas where the maximum amount of vehicles per hour exceeded the average volumes that the toll plaza could process were identified as congested locations. Several problems plazas were targeted for E-ZPass implementation to help alleviate congestion and increase toll plaza throughput. These plazas included the Albany/Northway (Interchange 24) on the control system and the Tappan Zee Bridge, Harriman and Buffalo City Line Barriers.

These same locations were analyzed to determine the capital cost savings of increased throughput on E-ZPass implementation. Hourly data for the week of December 1 through December 7, 1998 were obtained for these locations. Table 5 compares the peak hour volumes from both the 1990 and 1998 surveys and E-ZPass market penetration.

Table 5
1990 - 1998 Increase In Toll Plaza Throughput

	October 1990 Survey Maximum Peak Hour Volume		December 1998 Survey Maximum Peak Hour Volume (E-ZPass Market Share)		Change	
Tappan Zee Bridge	6,791		7,729 (81%)		14%	
Buffalo City Line	2,544		2,920 (37%)		15%	
Control System	Entry	Exit	Entry	Exit	Change	
					Entry	Exit
Interchange 24	3,425	3,437	3,980 (54%)	3,674 (44%)	16%	7%

In 1990, when the Tappan Zee Bridge Barrier was considered at or near capacity, the plaza could process 6,791 vehicles per hour. By 1998, this number increased by 14 percent, to 7,729 in 1998. This facility had 13 lanes throughout this period. Without the higher processing rates that E-ZPass provides, the NYSTA would have had to add a minimum of two lanes to handle throughput demand. The capital cost of constructing new lanes, moving the toll administration building and purchasing additional land would run between $10 - $15 million dollars.

At the Buffalo City Line, 37 percent more traffic is processed through the facility now, than was in 1990. This plaza has 7 lanes and would require 3 additional lanes to handle the same number of vehicles without the benefit of E-ZPass. Similar expenditures as those noted for the Tappan Zee Bridge would require additional capital costs of $8 - $10 million dollars.

The Albany/Northway Interchange 24 on the Control System, another station, which was noted as a congestion prone facility in the 1991 report, experienced a 16 percent growth in throughput at the entry lanes and 7 percent increase in throughput at the exit lanes. With a total of 14 lanes, this plaza would require additional two lanes to process the same number of vehicles without E-ZPass. This would range between $8- $10 in additional capital cost and may not be possible due to geometric constraints.

It is also important to note that the capacity of a toll plaza that has been retrofitted with ETC can actually have a greater capacity than the roadway that feeds into it. The Tappan Zee Bridge, for instance, has been estimated to have a capacity of 7,200 to 7,400 vehicles per hour. With 13 lanes, 6 of which are dedicated to E-ZPass, capacity of the toll plaza is approximately 8,800 vehicles per hour. This is illustrated during the AM peak period when traffic is greatest on the bridge, backups occur both before and immediately after the toll plaza but there are no queues at the toll lanes where E-ZPass market share is often greater than 80 percent.

B. TRAVEL TIME SAVINGS

The implementation of ETTM technology has not only increased plaza throughput, but also has shortened queues and reduced travel time. Non-stop transaction processing is faster than both manual cash transaction lanes and automatic coin machine lanes. As the E-ZPass market share increases, average plaza transaction time decreases. This is most apparent at dedicated E-ZPass exit lanes on the Control System. In the 1991 study,

average transaction time for a dedicated E-ZPass lane was estimated at approximately 10.5 seconds per passenger car and 29.5 seconds for a commercial vehicle. If a dedicated E-ZPass lane can process 1,000 vehicles per hour, average transaction time is only 3.6 seconds per vehicle, savings of at least 6.9 seconds per passenger car. The greatest times savings, however, is realized in the elimination of queues due to the reduction in transaction time. In the 1991 survey, queues of over 20 vehicles, which took up to two minutes to process, were observed during peak periods at some toll plazas. With ETC, there are virtually no queues at interchanges and barriers where there once was often heavy congestion.

In the future, as part of the Williamsville Barrier relocation program, the Authority plans to have highway speed E-ZPass lanes, which do not require the driver to reduce speed. Similar facilities such as the Georgia 400 Toll Road have this technology which provides significant time savings as compared to cash transactions. It is anticipated that these lanes will further increase patron travel timesaving for Thruway users.

C. SAFETY

1. Toll Collector Safety

The introduction of E-ZPass and dedicated E-ZPass lanes introduced a new lane-crossing environment for toll collectors. In 1993, steps were taken to develop new safety initiatives to aid collectors and staff in crossing toll lanes. These included the introduction of safety vests, marking crosswalks on the pavement, cones or signs adjacent to dedicated lanes to remind the crossing staff that they were approaching a dedicated lane. The Authority also prepared training videotapes for crossing lanes. Many of these practices established in 1993 have been adopted by other toll agencies across the United States.

2. Operational Safety

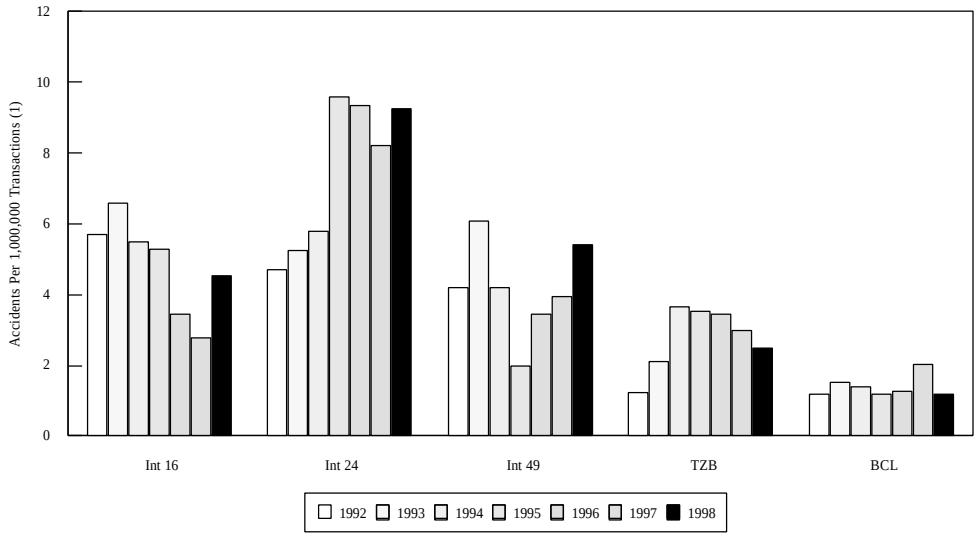
Accident data was obtained from the Thruway from 1992 through 1998 to analyze the effect ETC implementation had on the total number of accidents. Total number of accidents, percent of E-ZPass related accidents and average market share for Interchanges 16, 24 and 49 and The Tappan Zee Bridge and Buffalo City Line Barriers from 1992 through 1998 are illustrated in Table 6. While with increasing E-ZPass market share, the percent of total accidents that were E-ZPass

related increased, this increase at all locations was lower than the increase in E-ZPass use. Figure 7 shows the average number of accidents 1,000,000 transactions at the same five toll plazas. At all five study locations, the total number of accidents as a proportion of total transactions either decreased appreciably or remained the about the same. While this can not be attributed to E-ZPass necessarily, it is fair to say that ETC did not result in an increase in total accidents.

Table 6
Summary of Total and E-ZPass Related Accidents

Year	Toll Plaza														
	Interchange 16			Interchange 24			Interchange 49			Tappan Zee Bridge			Buffalo City Line		
	Total Accidents	Percent E-ZPass Related Accidents	E-ZPass Market Share (1)	Total Accidents	Percent E-ZPass Related Accidents	E-ZPass Market Share (1)	Total Accidents	Percent E-Zpass Related Accidents	E-ZPass Market Share (1)	Total Accidents	Percent E-ZPass Related Accidents	E-ZPass Market Share (1)	Total Accidents	Percent E-ZPass Related Accidents	E-ZPass Market Share (1)
1992	40	0%	0%	49	0%	0%	9	0%	0%	25	0%	0%	8	0%	0%
1993	48	0%	0%	55	0%	0%	14	0%	0%	44	0%	7%	10	0%	0%
1994	41	0%	0%	62	0%	0%	10	0%	0%	78	0%	32%	9	0%	0%
1995	38	3%	1%	104	5%	1%	5	0%	1%	77	6%	34%	8	0%	0%
1996	27	4%	4%	105	10%	4%	9	0%	4%	77	4%	37%	9	0%	5%
1997	23	4%	17%	95	19%	17%	11	0%	17%	68	21%	45%	15	0%	11%
1998	43	9%	28%	101	16%	28%	15	7%	28%	58	16%	53%	10	20%	22%

Figure 7
Accidents Per 1,000,000 Transactions at NYSTA Toll Plazas



(1) Int 16 - Accidents Per 100,000 Transactions

D. TRAFFIC MONITORING

TRANSCOM (Transportation Operations Coordinating Committee) started the program TRANSMIT (TRANSCOM System for Managing Incidents and Traffic), a FHWA-funded operational test to determine the feasibility of using automatic vehicle identification technology for traffic monitoring and detection of incidents. Through TRANSMIT, readers were installed between Spring Valley and Tappan Zee Bridge which pick up signals from random drivers who have transponders. This information is not used to identify drivers and the account numbers of the tags used by TRANSMIT are scrambled to maintain each drivers anonymity. An average speed for this section of roadway is determined as a number of E-ZPass equipped vehicles pass a series of readers. The information is also entered into an algorithm to identify traffic incidents. The information is recorded without the owner's identity and provides a both real time and historical data. Eventually TRANSMIT could be expanded for the entire Thruway system allowing the Authority to get information for any section of roadway.

Traffic monitoring continues to be eventually be expanded off of toll facilities in areas where a certain E-ZPass market share is achieved. Already there are plans to install readers in the New York City metropolitan area. These readers will relay information that will be used for both traffic management and traveler information purposes.

VIII. SYSTEM COSTS

This section will discuss operating costs associated with the implementation of ETC on the Thruway. Of significance to this section is that a reduction in operating costs was not one of the primary objectives of implementing E-ZPass on the Thruway. It was anticipated to result in a reduction of toll plaza capacity expansion costs, and an appropriate reduction of the in-lane operating costs associated with the expanded plaza. However, some of the other cost savings of existing operations that would be attained were offset by new costs associated with ETC. Some of these are briefly summarized.

A. TRANSACTION COSTS

Expected cost savings were primarily focused on a reduction in the required number of toll collectors. This reduction was expected to occur over a long period of time through attrition. Some of these reductions in the regional labor force would be offset by labor requirements for the customer service center and related back office needs. Other anticipated cost savings included reduced money handling costs and in-lane maintenance costs. These reductions did happen.

The operation of E-ZPass introduced several new operating cost items. Though many of them may be insignificant they do offset savings over the traditional methods of toll collection. The introduction of the customer account brought about monthly direct mailings of account activities that numbers in the hundreds of thousands. Each one receiving a statement in an envelope with postage.

Another “new” cost comes from the charges assessed for credit card transactions by the various credit card issuers. Depending on the issuer, this may range as high as 4 percent of the money being collected. In simple terms, that 4 percent result in $0.96 of toll revenue collected for each $1.00 of toll charged to a customer’s credit card. This must be considered an operating cost. Other costs include the distribution of transponders, account call handling, account processing and other customer service center related items.

Operating cost data specific to the plazas under study can not be separated out of the Authority costs, nor is it easy to segregate specific costs and savings associated with E-ZPass from other operating costs. It is however, possible to review operating costs in general and the implementation of E-ZPass has had no negative impact on the cost to operate the Thruway.

B. ENFORCEMENT COSTS

The primary enforcement costs are associated with initial capital expenditures for the violation equipment and processing bureaus. These capital costs include cameras installed at the toll plazas, the bandwidth for violation identification, the construction costs for the centralized Staten Island violator-processing bureau.

There are also a number of recurring capital costs for violator notification. This includes processing the notices, postage and follow up postage for violator notices and salaries for processing bureau employees.

C. LIFE CYCLE OF TECHNOLOGY

Electronic Toll Collection has several new components of life-cycle costs when compared to traditional toll collection. Foremost among these is the battery life of the transponder. The manufacturer estimates an average life of some 7 years with the typical life ranging from 5 to 10 years. In consideration of the battery life, replacement of aging transponders must be part of the life cycle cost of the system. Battery life alone does not figure into the replacement cycle. Other issues such as the evolution of the technology and any emerging national standard for the transponder devices must be considered.

As discussed earlier a great deal of benefits are derived from non-Thruway transponders using Thruway facilities. Given this, any replacement cycle must consider future standards and the continuation of reciprocity with other E-ZPass agencies. Currently, Authority staff is active on national committees and included in planning accommodations for both future and a present ETC technologies.

IX. SYSTEM PERFORMANCE

A. SIGNAGE

Analysis of the success of the signage system is based on discussions with New York State Thruway personnel, violation rates and anecdotal data from Thruway users. The consensus is Thruway E-ZPass signage is clear and now that it has been in place for several years, customers are familiar with the signs. The current violation rates in Thruway's E-ZPass lanes is just over one percent, lower than it was several years ago and considerably lower than the five to ten percent violation rate for other toll facilities.[1]

With the arrival of IVHS technology at the Thruway's toll plazas, three payment methods became available requiring a new approach to signage guiding drivers to the correct lanes. The primary consideration for E-ZPass sign standards was that the signs were clear, legible, and easy to understand. The signs needed to effectively broadcast several pieces of information to toll plaza customers so that decisions could be made well in advance of the toll plaza. Unclear signage would lead to late decisions creating hazardous weaving conditions and an increase in toll plaza violators. One of the key benefits of the E-ZPass system is travel time savings which is minimized when non-tagholders enter E-ZPass only lanes. As such the signage system needed to accomplish several tasks in order to ensure that all the lanes would function efficiently.

1. Variable Message Signs and Traffic Monitoring

Prior to the Thruway's E-ZPass system, roadway signs provided advance information about the toll plaza ahead and the amount and method of paying tolls. The sign followed uniform design standards (green with white letters) according to the Manual of Uniform Traffic Control Devices (MUTCD).

At the Spring Valley toll barrier, E-ZPass lanes were initially located together in the middle of the toll plaza and exact change lanes remained on the left. Some erratic movement and weaving in advance of the toll barrier was expected. However, it was also expected that once ETC was fully operational, drivers would be familiar with the toll plaza layout and erratic movements and weaving would be minimized. Long after the E-ZPass was fully operational at the Spring Valley

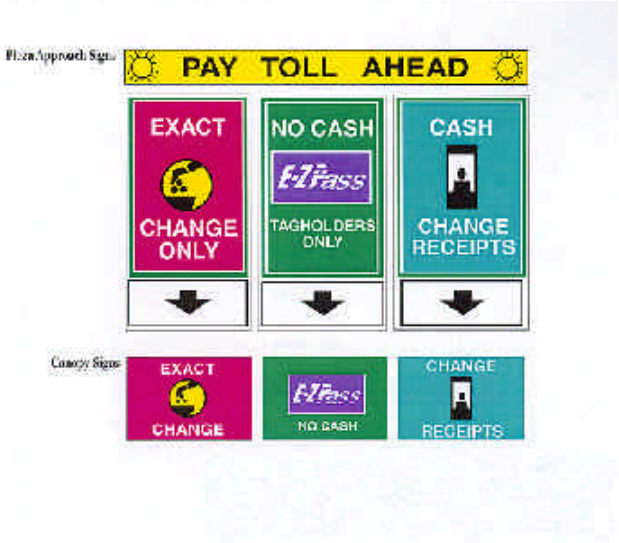
[1] New York State Thruway Authority

toll barrier, studies indicated that lane confusion still occurred at levels far above those expected.

Because the Thruway varies the number of lanes by peak period, direction of travel and general level of usage, the new E-ZPass signage would have to be flexible. Existing signage were reviewed and two options were developed. The first option involved installing "high tech" variable message signs on top of the toll plaza canopy and in advance of the toll plaza. The second option would involve a new type and placement system of toll plaza signage. The latter option was selected.

New color coded signs with logos for each option were developed. Only MUTCD approved colors were selected because they had been tested by the traffic engineering community for visibility. The message signs are uniform in size but have different colors with distinct logos to differentiate toll payment options. Signs in the "Exact Change Only" lanes are red. Signs in the "E-ZPass Only" lanes are green with the purple E-ZPass logo and signs in the "Cash-Change Receipts" lanes are blue. The final signs selected are presented below:

Figure 8 - NYSTA E-ZPass Signage



2. Frequency and Type of Signage

Where and how often a driver would encounter a payment sign in advance of the toll plaza would contribute considerably to the ease of the decision making process. The overall concept for the approach signage included installing three signs for each payment type: two signs along the roadway and one on the plaza canopy. The approach signs would designate the toll plaza area (left, center, and right) for each payment option. The canopy signs would be variable.

Two canopy sign options were proposed: electronic or drum-type variable signage. Electronic signage technology options limited the "uniformity" of the look of the signs and therefore drum-type system was selected. That is, electronic signage might not look exactly like the other signs (color, logo, etc.) so rather than establishing an easy to read signage system, the electronic signs would add yet another sign to decipher. The drum-type signs, an available and tested technology, would look identical to each other and to the other E-ZPass signs and would be efficient in establishing a uniform driver response.

Thruway drivers generally encounter their first E-ZPass signs approximately 1 to 1 ½ miles from the toll plaza. The first sign indicates the type and location of the payment lanes (i.e. Exact Change Only - Left Lanes, E-ZPass No Cash 5MPH-Center Lanes, and Cash Receipts- Left Lanes). The second sign is located approximately ½ mile to 1/3 mile after the first. This sign provides information on the price of the toll and the distance to the Toll Plaza (i.e. Tollbooths ½ Mile-Cars 40¢). Within the last ½ mile of the toll plaza, individual message signs are installed on the roadside indicating the location of each lane payment option type. Variable message signs on the toll plaza canopy indicate whether lanes are opened or closed and in which direction traffic is flowing.

At the Spring Valley toll barrier, where three toll collection options existed, grouping similar lanes worked well. Grouping allowed advanced notification to drivers regarding the location of their desired lane. At most facilities, the Thruway has found it important to keep the lanes in the same location. Drivers generally become familiar with the layout of the plaza and no longer need to look at the signs.

The same color sign system has been implemented by the Peace Bridge and has been recommended for use by the NJETC Consortium. In general, only minor

adjustments have been made to the original signage at several toll plazas. The Thruway installed a flashing yellow light above the E-ZPass lanes to call attention to these lanes. This has further minimized weaving and lane violation.

The system developed in the NYSTA program has received a broader reception in the industry. For instance the flashing yellow light has been adopted by several other toll agencies help identify E-ZPass lanes.

X. TRANSPORTATION SYSTEMS

A. AIR QUALITY

The U.S. Environmental Protection Agency identified seven air pollutants as being of concern nationwide. As required by the Clean Air Act, National Ambient Air Quality Standards (NAAQS) have been established for six of these pollutants. Because of the concentration of these pollutants, the New York Metropolitan Area was classified as a severe ozone non-attainment area under NAAQS. Carbon monoxides (CO) produced by all vehicles and inhalable particulate matter (PM10) from diesel-powered vehicles is of primary concern for the Thruway. In congested areas such as toll plazas, CO and PM10 are more concentrated and more likely to be detrimental to air quality. As E-ZPass market share has increased, decreased travel times and shorter queues at all toll plazas have resulted. This in turn has led to reduced pollutant concentrations, an overall improvement in air quality at many of the toll plazas and helped the Thruway due its part to meet NAAQS

XI. CONCLUSION

Since full implementation of ETTM technology on both the mainline and the barrier systems, the New York State Thruway has achieved all short- and long- term implementation and policy goals set in 1991. E-ZPass has increased traffic throughput, decreased peak hour congestion in some areas and allowed the Thruway to avoid expensive and disruptive plaza expansion.

The E-ZPass technology was compatible with existing NYSTA technology enabling a smooth transition for patrons. One toll collection system was installed for both the Barrier System and the Control System. The collection system had the same transponders, the same signage and plaza traffic considerations so that the motorist would not be confused by different systems and

different technologies. Similarly, the goal of plug compatibility, that is the ETTM equipment would be compatible with current NYSTA equipment was ultimately achieved.

Perhaps the most significant result of the E-ZPass system is that it created a more efficient method of travel and improved the way commuters feel about their trip to work. The long-term market turned out to be not only just toll barrier customers and permit/cash commuters, but also commercial account holders for the control system. Tags are transportable and can be removed from one vehicle and placed on another. This enables customers to register one tag per household even if there are several cars. By removing the tag from the windshield., tags can be disabled if the customer wishes not to use it for a particular trip.

Although in the 1991 Report compatibility was assigned low priority to coordination with other toll agencies, the NYSTA has achieved full tag reader compatibility with and through the Inter Agency Group. The Thruway introduced a new and more convenient way to travel for commuters throughout the travel corridor and provided an important foundation for ETTM technology in the northeast.

After 1996, bond covenants would have depended on possible successor bond covenants, which should consider ETTM technology. Because toll payment is pre-paid, the issue of liability for lost revenue was no longer a concern when structuring the bond covenants. As such, current bond covenants include ETTM technology on the NYSTA.

The long-term enforcement policy goal of pursuing legislation to allow photo enforcement was certainly achieved. In addition, legislative policy also mandated the method of ticketing via mail and allows the NYSTA to contact local Departments of Motor Vehicles for information regarding toll violators. All required permits and approvals for placing tags on the windshields of cars were obtained from the commissioner of the Department of Motor Vehicles. The legislation and enforcement policy set by the NYSTA has been used as model by the NJETC Consortium and by other toll agencies throughout the Country.

Long term policy goals for lane configurations involved full implementation of dedicated non-stop lanes operating at 20-30 mph based on safety considerations. Currently, toll plaza speed limits are typically set at 5 mph, but cars generally travel at closer to 10 mph. While the selected technology has the ability to read tags at 65mph, safety considerations prohibited toll plaza lanes from allowing such high through speeds. Currently, the NYSTA is considering establishing high-speed toll lanes at the Williamsville toll barrier, Interchange 50.

The implementation of ETTM technology on the New York State Thruway represented an important milestone in improving the way people travel and the way they view their commute. The Inter Agency Group coordination effort represented the next milestone in what may eventually end up a fully integrated travel network throughout the eastern United States.