AET CONVERSION AND PRIORITIZATION STUDY
EXECUTIVE SUMMARY

Maryland Transportation Authority

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The Maryland Transportation Authority (MDTA) has conducted an AET Conversion and Prioritization Study, planning for the conversion of Maryland's seven toll plazas to all electronic tolling (AET). AET would provide toll collection at highway speeds through the electronic methods of *E-ZPass*® and video tolling, with no cash transactions occurring on the roadway. Consequently, the existing toll plazas, including toll islands/booths, canopies, and associated elements, would be removed. MDTA has already implemented this form of tolling on MD 200 (the Intercounty Connector – ICC) and will implement it on the I-95 Express Toll Lanes (ETL) in 2014.

The AET Conversion and Prioritization Study consists of analysis of two major components:

1. Physical conversion of the existing toll plazas to an AET configuration, which includes full or partial removal of toll plaza elements, location for the AET toll zone/gantry, construction phasing to remove the toll plaza and implement AET, operational changes, and cost estimates for the conversion.
2. Prioritizing the conversion order of MDTA's facilities based on traffic composition (volume, percentage of *E-ZPass®* use, and number of out-of-state users), potential revenue impacts, and consideration of the additional AET conversion activities needed within MDTA to accommodate AET.

A | BACKGROUND

Over the last fifteen years the toll industry has been revolutionized by the near universal adoption of electronic toll collection (ETC), which allows tolls to be collected without vehicles having to stop at a toll booth. As a result, tolls may be collected much more quickly and plaza-wide delays are reduced. MDTA has offered *E-ZPass®* (initially M-Tag) since 1999, since then there has been broad support from customers as demonstrated by the fact that 73 percent of all toll transactions were made using *E-ZPass®* in the first seven months of 2013. *E-ZPass®* use at Maryland's seven toll plazas is projected to continue to grow through the

end of the decade. The use of *E-ZPass®* has positively affected traffic operations at MDTA toll plazas. In general, and despite growth in overall traffic volumes, traffic queues have been greatly reduced during most peak traffic periods, and the number of lanes needed for cash collection has decreased. For example, at the Key Bridge toll plaza during peak hours, only two of six lanes in each direction accept cash payment, and on many days, one lane would be sufficient to accommodate the cash-paying customers. The result of increasing use of ETC is the decreasing need for large toll plazas with many toll lanes to process cash transactions.

MDTA's experience with a customer shift in favor of ETC is consistent with that of toll agencies across the country. This trend has led agencies to provide fewer and fewer lanes for cash-paying traffic. Many agencies are following this trend and are in the process of implementing, or have already implemented, AET.

With AET, legacy toll collection methods (cash, tickets, tokens, etc.) are eliminated and toll collection is entirely comprised of electronic methods. Typically, this includes transponder-based toll collection (e.g., *E-ZPass®*), and video toll collection where photographs of license plates are captured for vehicles not equipped with a transponder. The owner of the vehicle is then identified and billed.

Toll agencies are moving toward AET for a number of reasons, including the following:

- Improved safety from the elimination of toll plazas;
- Improved operations from the removal of the toll barrier;
- Improved customer service because of additional account functions;
- Reduced infrastructure; and
- Reduced toll collection cost.

However, AET does come with challenges, including:

- Capital costs to convert an existing plaza to an AET configuration;
- Operations and maintenance costs associated with new AET gantries and an expanded Back Office;
- Marketing and public education needed to explain AET to customers;
- Potential revenue leakage from uncollected tolls form video toll users; and
- Need for reciprocity agreements with other states for toll enforcement and collection.

AET has been implemented across the country on one or more facilities operated by the Miami-Dade Expressway (MDX) and Florida Turnpike Enterprise (FTE) in Florida, North Texas Tollway Authority (NTTA) and Central Texas Regional Mobility Authority (CTRMA) in Texas, E-470 in Colorado, the I-495 Express Lanes in Virginia, and Triangle Parkway in North Carolina. In addition, several *E-ZPass®* agencies are studying or preparing to implement AET, including the Pennsylvania Turnpike Commission, the Metropolitan Transportation Authority (MTA) in New York, the Atlantic City Expressway, and the Massachusetts Turnpike Authority.

Lessons learned from past or on-going AET projects are useful in identifying strategies that could lead to a more successful conversion. Lessons learned from these projects include the following:

- A focus on **video toll processing** is important;
- Educating the customers on how AET works and what **payment options** are available is vital;
- Improving **interoperability** with nearby toll agencies is very helpful;
- **Revenue leakage** is likely to increase as the system transitions to AET, and **toll collection costs** are likely to decrease;
- Legislative authority to codify certain **penalties** for repeated violations may be necessary;
- **Business rules** should be developed or modified to accommodate AET; and

- Converting to AET is an **evolutionary process** and toll agencies will have to adapt to challenges through the process, including modifying the approach as the conversion progresses.

Several factors could influence the timing of MDTA's conversion to AET, including the following:

- The potential for **lost revenue** due to the increase in video tolling, especially from out-of-state users;
- The implementation of MDTA's revised **violation and citation process** (passed by the Maryland Legislature in 2013);
- **Interoperability** with agencies outside of the *E-ZPass®* Group;
- **Reciprocity** with other states to legally enforce Maryland tolls for out-of-state users;
- **Education** of the public and politicians on what AET is, how it works, and why it is being implemented; and
- The **capital investment** needed to convert existing facilities to AET.

B | AET CONVERSION

AET APPROACHES AND FEASIBILITY

AET could be implemented in one of two approaches for each of MDTA's seven toll plazas: full AET conversion and partial AET conversion. Both of these approaches provide toll collection at highway speeds through the electronic methods of *E-ZPass®* and video tolling, with no cash transactions occurring on the roadway.

The full AET conversion entails removal of the entire existing toll plaza elements (booths, islands, canopy, pavement, etc.) and reconstruction of the highway to match the typical section upstream and downstream of the plaza. Partial AET conversion entails the removal of a portion of the existing toll plaza elements (booths, islands, canopy, etc.) to provide an open highway alignment through the toll plaza. The rest of the plaza elements would remain until demolition is required to implement future projects.

Partial AET conversion offers the advantage of only demolishing/constructing what is required to provide an open highway alignment, which could be less expensive and quicker to implement than full AET conversion. However, this approach would leave unneeded toll plaza infrastructure, which could be unsightly and present a maintenance and security concern. In addition, with partial AET conversion, roadway alignments could be somewhat less ideal (i.e., contain more horizontal curves) than the alignments proposed for full AET conversion.

Full AET conversion and partial AET conversion are feasible at all seven MDTA toll plazas for the following reasons:

- There are viable locations for new AET tolling zones (gantries) near each plaza,
- The toll plazas could be reconfigured and reconstructed to provide AET alignments, and
- The modifications could be implemented with relatively straightforward construction phasing.

ENGINEERING AND OPERATIONAL CONSIDERATIONS

There are engineering and operational issues associated with converting the MDTA toll plazas to AET as described below.

- **Implementing cashless tolling at the Nice Bridge –** The low-speed nature of this facility may allow for cashless tolling through the existing toll lanes as a preliminary step to full/partial AET conversion.
- **Tunnel maintenance –** Routine tunnel maintenance requires regular bore closures and the existing toll booths (southbound at the Fort McHenry Tunnel and northbound at the Baltimore Harbor Tunnel) are used to assist with the maintenance of traffic during these operations. Currently, toll lanes can be closed

and maintenance of traffic operations can be used to direct vehicles to the open bore. With AET, these operations would have to be modified.

- **Contra-flow operations at the Bay Bridge –** Contra-flow operations are implemented by manually shifting cones within the median crossover areas on both sides of the Bay Bridge. However, the proposed AET configuration would substantially alter the contra-flow lane approaching the toll plaza, with a dedicated lane for contra-flow operations beginning one mile in advance of the toll plaza. MDTA could continue manual operations to open/close this lane or explore the use of an automatic system, such as lane gates similar to those used on reversible lane facilities to open and close the lane.

AET CONVERSION COSTS

Preliminary cost estimates were developed for the full and partial AET conversion alternatives at each of the seven MDTA facilities. The partial AET conversion costs are lower than the full AET conversion costs because less initial demolition and construction would be required. The ranges of costs are summarized in Table ES-1 and include neat construction, preliminary engineering, and project administration and overhead.

Table ES-1. AET Conversion Costs

Facility	Full AET Conversion ($M[1])	Partial AET Conversion ($M[1])	
		Minimum	Preferred
I-95 / JFK Highway[2]	$17.5 – $21.5	$11.5 – $14	$13 – $16
US 40 / Hatem Bridge[2]	$10.5 – $13	$8.5 – $10.5	$10 – $12
I-95 / Fort McHenry Tunnel	$31 – $38	$16 – $19.5	$27.5 – $33.5
I-895 / Baltimore Harbor Tunnel	$33.5 – $41	$28 – $34	
MD 695 / Key Bridge	$19 – $23	$12.5 – $15.5	$14.5 – $18
US 50/301 / Bay Bridge	$20.5 – $25	$15 – $18	$16.5 – $20
US 301 / Nice Bridge	$13 – $16	$10 – $12.5	
TOTAL	**$145 – $177.5**	**$101.5 – $124**	**$119.5 – $146**

1. All values are in 2013 dollars.
2. Assumes that one-way tolling will be maintained.

No major environmental impacts are anticipated to convert any of the toll plazas to AET, with the possible exception of the Baltimore Harbor Tunnel (BHT) where extensive interchange and surface road reconfigurations would be needed. Additional detailed engineering analysis would be needed to identify potential impacts from converting the BHT to AET.

C | AET PRIORITIZATION

TRAFFIC EVALUATION

MDTA provided monthly traffic volumes for each toll plaza, which included vehicle classifications and payment types. The data was compiled to allow for an analysis of typical weekday conditions. VISSIM traffic simulation models were developed for all plazas to replicate existing conditions and evaluate AET.

Only the AET condition was modeled for the Hatem Bridge. Existing conditions were not modeled because MDTA eliminated the AVI Decal in September 2012, during the study, and users were in the process of adopting the new E-ZPass® commuter program. Therefore, modeling of existing conditions would not provide an accurate representation of actual conditions after the shift to the new E-ZPass® commuter program.

The results of the VISSIM analysis indicated that AET would improve operations at all locations. Both vehicle delay and overall travel times would be reduced. The summary results for each location are provided in Table ES-2 below.

Table ES-2. VISSIM Model Results

Facility	Summary Results
I-95 / JFK	• Average peak travel times decrease 19% (weekday) to 25% (summer weekend) • Average peak delays decrease 8% (weekday) to 12% (summer weekend)
US 40 / Hatem	• Existing conditions were not modeled because at the time of the study there was a substantial ongoing shift in the toll payment methods accepted at the Hatem Bridge. Users were shifting from a large majority AVI Decal to large majority *E-ZPass®*, and modeling existing conditions during this transition would not have yielded an accurate picture of non-AET conditions. • In addition, the Hatem Bridge differs in several important respects from MDTA's other plazas. It is a lower speed facility with signalized intersections on either side of the Bridge and AET is not anticipated to significantly improve traffic operations. Rather, implementing AET should improve safety, decrease traffic maneuvering along eastbound US 40, and lead to lower vehicle emissions and noise associated with deceleration and acceleration. • Modeling of the AET condition indicated no delay along eastbound US 40.
I-95 / FMT	• Average peak travel times decrease 10 to 12% • Average peak delays decrease 31 to 37%
I-895 / BHT	• Average peak travel times decrease 15 to 24% • Average peak delays decrease 11 to 14%
MD 695 / FSK	• Average peak travel times decrease 13 to 20% • Average peak delays decrease 48 to 79%
US 50 / 301 / Bay	• Average peak travel times decrease 70% (summer Friday) • Average peak queue lengths decrease 80%; maximum peak queue lengths decrease 72% (summer Friday)
US 301 / Nice	• Average peak travel times decrease 20 to 29% • Average peak delays decrease 76 to 83%

REVENUE ANALYSIS

Converting the existing toll plazas to AET could affect toll revenue because AET presents an environment where cash is no longer accepted and all non-E-ZPass® users pay through video tolling. Video tolling could increase the potential for uncollectable or unpaid tolls and change the toll collection costs. A preliminary revenue analysis was completed to understand the potential effects that AET could have on toll revenues. Overall, the preliminary analysis indicated that AET would result in higher annual partial net revenue (gross revenue minus toll collection costs) than the No Build condition at all plazas except the Hatem Bridge, where AET and No Build revenues are expected to be the same. All projected partial net revenues were derived from assumptions that could vary widely from actual conditions.

Sensitivity analyses were completed to capture some of the potential variability in the key factors that could affect revenue. In all cases, AET partial net revenue would be higher than the No Build partial net revenue, except at the Hatem Bridge where the projected revenue was anticipated to be the same with the No Build and AET.

AET COMPARISON AND PRIORITIZATION

As part of the prioritization analysis, the following elements were evaluated: traffic operations, E-ZPass® use, percentage of out-of-state vehicles, revenue implications, and unique factors at each facility. In general, the team did not consider cost or complexity/duration of construction in the evaluation of priority order because it was assumed that MDTA would embark on a conversion of all facilities at some point, and the incremental cost of conversion would not affect the overall order.

The facilities were ordered into relative consideration levels (high, medium, and low):

- **High**: MD 695 / Key Bridge and US 40 / Hatem Bridge;
- **Medium**: I-95 / JFK Highway, US 50/301 / Bay Bridge, and I-95 / Fort McHenry Tunnel; and
- **Low**: I-895 / Baltimore Harbor Tunnel and US 301 / Nice Bridge.

The facilities that fall under the "medium" consideration level would not be converted to AET until after Maryland enters into toll enforcement reciprocity agreements with nearby states. These facilities have higher out-of-state volumes than the facilities that fall under the "high" consideration level and therefore may have a higher risk of revenue leakage from uncollected video tolls.

ADDITIONAL AET CONVERSION ACTIVITIES

Conversion to AET at one legacy toll facility will have impacts on the manner in which MDTA operates. In broad terms, such a conversion would impact site footprint and infrastructure, operations and maintenance, staffing, and customer service issues. In addition, reciprocity agreements need to be negotiated with adjacent states (at a minimum) like Virginia, Delaware, New Jersey, Pennsylvania, and New York. Conversion of all seven legacy toll facilities would greatly increase those impacts. In addition, extensive public outreach will be needed to inform MDTA customers of the conversions. Each of these elements presents its own challenges and opportunities that will need to be studied in more detail as MDTA moves closer to AET conversion.