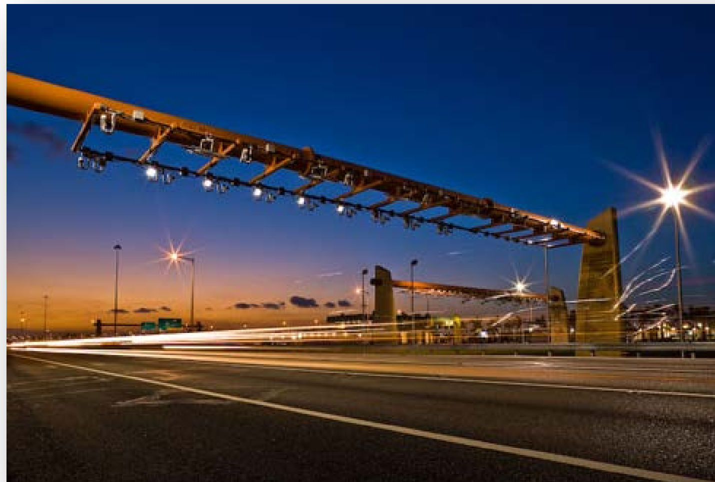
ELECTRONIC TOLL COLLECTION SYSTEMS


Miami-Dade Expressway Authority

Cost: ●●○○○
Time: Moderate
Impact: Facility
Who: Toll Authority
Hurdles: Technology

Description

Typical methods for collecting tolls are manual collection, automatic toll collection via coin machines, and electronic toll collection (ETC).

Manual toll collection is the simplest form of toll collection, in which a collector operating from a booth collects the toll. Automatic coin machines allow collection of several methods of payments such as coins, tokens, smart cards, and credit cards without the need for a collector. ETC is the most complex and latest method for collecting tolls. Although it has been in use for more than 20 years, ETC continues to evolve. ETC lanes improve the speed and efficiency of traffic flow and save drivers' time.

An ETC system is capable of electronically charging a toll to an established customer account. The system can determine whether a passing car is registered, automatically charging those vehicles, and alert the local highway patrol about users that are not registered. The ETC method allows vehicles to pass through a toll facility without requiring any action or stopping by the driver.

Target Market

Any new or existing toll or priced facility is a candidate for deploying an ETC system. The reliable and relatively inexpensive technology means this is a standard element of modern toll roads.

How Will This Help?

Typical ETC systems can improve the traffic flow through the toll area. Manual toll collection lanes handle about 350 vehicles per hour and automatic coin machine lanes handle about 500 vehicles in the same time period. An ETC lane can process 1,200 vehicles per hour when the lane is located in a traditional plaza configuration with island structures on each side of the lane and up to 1,800 vehicles per hour in all-electronic tolling (AET) configurations.[1] An AET lane offers over five times the flow rate of a manual lane and nearly four times the flow of an automatic coin machine lane.

Most ETC lanes are less expensive to build and operate than traditional toll collection methods. Cost data averaged for five toll facilities in five states showed electronic toll collection systems provide cost savings of over $40,000 per lane for equipment costs, and $40,000 per lane in annual operating and maintenance costs compared with automatic coin machines, and $135,000 per lane in annual operating and maintenance costs compared with manual tollbooths.[2]

ETC lane usage can decrease emissions in the area. Practitioners have reported that the ETC system at three toll plazas in Baltimore, Maryland, with dedicated ETC lanes located in a traditional plaza configuration with island structures on each side of the lane resulted in a

40 to 63 percent reduction of hydrocarbon and carbon monoxide, and approximately 16 percent reduction of nitrogen oxide in the study area.[3]

Implementation Examples

Georgia: The Georgia State toll authority is currently offering an application (Peach Pass GO!) for iPhones and Android phones that allows drivers to register the number of passengers in the vehicle to avoid being charged the typical toll. The phone application allows the same user access as home computers, provides toll users to check the status of their account. The application is similar to that of an E-ZPass Flex, which allows drivers to change their toll status in real-time.[4]

Several phone application developers are also currently working on creating programs that allow drivers to pay tolls via mobile phones. Typical systems require the driver to enter the license plate number before or immediately after their trip. The application is then directly linked to a PayPal account or bank card that is automatically charged on recognition of the vehicle from gantry-mounted cameras. This method of payment can avoid the expensive method of image based tolling and allow the toll authority to better serve non-account holders.[4]

Florida: ETC lanes started to be widely deployed in toll facilities in the early 1990s. First as a simple upgrade of manual lanes, where the converted dedicate ETC lane was still collocated within a traditional plaza and later, with the advances in RFID and camera technologies to process vehicles at freeway speeds, with ETC-only facilities such as ORT and AET facilities. There have been numerous studies that document the benefits of ETC. In Florida's University toll plaza, the addition of Open Road Tolling to the existing ETC mainline toll plaza decreased delay by 50 percent for manual cash customers and by 55 percent for automatic coin machine customers, and increased speed by 57 percent in the express lanes. These results are based on data collected during a 20-month period before, during, and after the plaza upgrades.[5]

New Jersey: A study conducted in late 2000 to evaluate the New Jersey Turnpike Authority ETC system implementation estimated a reduced delay at the toll plazas for all vehicles by approximately 85 percent for a total savings of about 2.1 million vehicle-hours per year.[6]

San Francisco, California: Researchers have developed several models for assessing ETC benefits and costs. One study ran a model using actual data for the ETC system at the Carquinez Bridge in the San Francisco Bay Area. The model estimated that the project would generate a benefit-cost ratio of 40 over the 10 year evaluation period. Time saving is a major direct benefit of ETC but other benefits include energy saving, emission reduction, and service improvement. Toll patrons were the primary beneficiaries.[7]

Application Techniques and Principles

Typical ETC systems are comprised of four subsystems: automatic vehicle classification (AVC), violation enforcement system (VES), automatic vehicle identification (AVI), and transaction processing, which includes a back office and customer service center.

Automatic Vehicle Classification: AVC systems consist of sensors installed in the toll lanes to detect and classify the vehicles for proper tolling. The AVC technique is most commonly performed using overhead equipment (laser or infrared detectors) or intelligent detector loops embedded in the pavement, but the detectors can also be placed on the roadside. The sensors are capable of perceiving and classifying vehicles in the open road tolling or all electronic tolling environments.

Violation Enforcement System: The primary goal of VES is to reduce the number of toll evaders with the assistance of multiple types of solutions. These methods range from fairly basic (audible and/or visual alarms) to complex systems, such as automatic license plate recognition camera-based solutions. Police enforcement and toll gates are other types of successful VES but can be costly and inefficient for high traffic volumes.

Camera-based VES captures images of each vehicle's front and/or rear license plates, depending on the toll authority's regulations. The necessary equipment consists of a camera (or array of cameras), an illumination system, and a controller card or computer that interfaces with the lane controller and/or the back office. A camera-based VES with plate recognition serves a dual purpose of enforcement and video tolling.

Automatic Vehicle Identification: The AVI systems properly identify each vehicle to charge the toll to a particular customer. This ETC method is typically done with various AVI technologies such as a bar coded label affixed to the vehicle, proximity card, radio or infrared transponder, and automatic license plate recognition. A majority of the AVI systems used involve radio frequency identity (RFID) and plate recognition technologies. The RFID system uses an antenna to communicate with a transponder in each registered vehicle, while video tolling identifies the license plate and charges a customer or sends a bill to un-registered drivers with help from the Department of Motor Vehicle's address database.

Back Office and Customer Service: The back office consists of the host and/or plaza system, customer service center, and violation processing center. The main functions of the host and plaza systems are to aggregate transactional data from all the lanes, data summarization, report generation, download of files such as a toll rates, toll schedules, and transponder status list. The customer service center is responsible for processing the AVI and video tolling transactions, matching transactions with account holders, debiting the correct toll amount, managing accounts, generating a valid tag list, and providing customer support to name a few. The violation processing center's main function is to process the images of the licenses plates, identify violators, and mail notices.

Issues

Most of the technological issues have been overcome after two decades of successful ETC implementations. The current issues with implementing ETC systems are related to interoperability and technology selection. Although all the toll facilities within Texas are currently interoperable (that is, one tag can be used on all toll facilities), there is a lack of interoperability with other states and with toll facilities at border crossings and in Mexico. The need for interoperability between border crossings and toll roads within the United States will continue to increase as toll roads are built near the border.

Technology selection directly impacts interoperability. If a toll agency selects a different RFID protocol then it might not be able to read customers from away agencies. Cities and local toll authorities should work together to create a compatible system throughout the state.

Who Is Responsible?

The local toll authority, the TxDOT toll division, or a concessionaire can be responsible for the implementation of an ETC system, depending on the toll location. In most cases a systems integrator contractor designs and implements these types of systems, and the operations and maintenance is performed by either the toll authority or a contractor.

Project Timeframe

The timeline for adding an ETC system will differ based on the size of the system and whether the project is a new toll facility, an upgrade, or an addition to an existing toll facility. The typical timeframe for deploying an ETC system may vary from nine months for simple upgrade or additions to two years or more for larger systems.

Cost

The cost of implementing an ETC system varies widely depending on the scope of the project, making it difficult to provide an exact cost. The system size (number of lanes and collection points), shoulder coverage, gantry type, and type of technology all affect the project price. The cost is also affected by whether the system is new, upgraded, or added onto. The price range will change based on the level of customized software required for the business rules, the back office operation (outsource or in-house), the project location, and the necessary signage.

The cost per ETC lane in an AET or ORT environment ranges from $100,000 to $200,000 for the cost of the lane equipment and its installation, and assuming the project reuses existing back office software, gantry, and right-of-way.

Data Needs

The practitioner should consider whether the toll system is a new installation, an addition, or an upgrade of the existing area. The throughput requirements, the technology used by the other toll facilities for interoperability, and the possibility of video tolling is also needed when implementing or improving a toll facility. Other necessary information includes the needs of variable pricing, possible outsourcing, and the need to handle cash-paying customers.

Electronic Toll Systems Best Practices

- Type of Location: Any toll facility.
- Agency Practices: Interoperability agreements with other in- and out-of-state toll agencies.
- Frequency of Reanalysis: Monthly during the initial launch, quarterly and annually thereafter.
- Supporting Policies or Actions Needed: Enforcement policy for out-of-state violators.
- Complementary Strategies: Adding new toll roads, active traffic management, variable pricing, improving lighting and signing, and managed lanes.

For More Information and References

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