



ELECTRONIC TOLL COLLECTION (ETC)

Electronic Toll Collection System

ETC Systems deploy various communications & electronic technologies to support the automated collection of payment at tollbooths. Collectively, the application of these technologies increase system throughput, improve customer service, enhance safety, & reduce environmental impacts. ETC & toll systems comprises of:

- Lane level Hardware and Software
- Plaza level Hardware and Software
- Data Centre Level Hardware and Software - Toll management center composed of applications, database, back office and audit servers, operation, supervision and audit operator workstations, and back office and toll management applications.

Components of the ETC Technology

- **Toll Collection System (TCS)** - One of the most successful applications of ITS is electronic payment. Non-stop electronic payment supports payment of vehicle tolls on the go. Smart travel cards support fare payment for combined transport services. Electronic payment applications integrate technologies for communications, data processing, data storage and microcomputing. The process comprises “front end” and “back-end” activities. “Front-end” activities are those seen by the user. The most common "front-end" hardware technologies are smart cards, transponders (tags, such as the EZ-pass widely used for electronic toll collection), and - increasingly - smart phones. “Back-end” activities are those related to payment processing, account maintenance, customer service and reporting.
- **Automatic Vehicle Identification (AVI)** - The AVI component of an ETC system refers to the technologies that determine the identification or ownership of the vehicle so that the toll will be charged automatically to the

corresponding customer.

- **Automatic Vehicle Classification (AVC)** - Vehicle type and class may have differentiated toll amount. The vehicle type may include light vehicles like the passenger car or heavy vehicles like recreational vehicles. A vehicle's class can be determined by the physical attributes of the vehicle, the number of occupants in the vehicle, the number of axles in the vehicles and the purpose for which the vehicle is being used at the time of classification (or some combination of these determinants). Some toll agencies use as many as 15 or more vehicle classes to assess tolls, although for ETC applications, four or five classes are more typical.
- **Automatic Number Plate Recognition (ANPR)** - ANPR System is an integrated hardware + software device that reads the vehicles license plate and outputs the license plate number in ASCII text of the number plate. It means Automatic License Plate Recognition system replaces, converts the task of manually typing the plate number of the bypassing vehicle into the computer system.
- **Video Enforcement Systems (VES)** - When used for ETC, the VES captures images of the license plates of vehicles that pass through an ETC tollbooth without a valid ETC tag. Although the deployment of these technologies makes the initial cost of installation very high, but there exits huge benefits accompanied with such high investment. Now it is possible for the vehicles passing a toll road not to have authorized tags, to have insufficient account balance for the required toll, or to have invalid tags. In such a case the violating vehicle should be identified and face legal action.
- **Traffic Control Centre System (TCCS)** - 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.

Toll Collection System (Man Managed Lanes)

The manual lane is used to collect toll manually by cash according to the vehicle category selected by the operator (in the toll booth).

At the entry lanes, an Automatic smart card Issuing Machine (ATIM) issues smart card indicating the entry station, date and time. The smart cards are then processed at the exit lanes. The toll due is calculated automatically on the basis of vehicle category selected by toll operator and distance traveled. Payment is collected by the toll operator

by cash and the vehicle is allowed to exit the lane. Transactions and violations occurring at the lanes are monitored in real-time at the Toll Plaza Control Center and recorded in the system database.

Toll Collection System (Man Managed Lanes) Hardware comprises of three Levels

- Lane level
- Plaza level
- Data Center Level

Lane Level Hardware

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| <ul style="list-style-type: none">• Booth & Booth PC• Industrial Grade Keyboard• Printer• Lane Controller• Automatic Smart Card Dispenser Receiver• Smart Card• Smart card Reader• Automatic Vehicle Classification | <ul style="list-style-type: none">• (AVC) System• Automatic Number Plate Recognition (ANPR) System• Toll Fare Display• Lane Vehicle Image Capture Camera• Plaza Incident Video Camera• Lane Traffic Light• Lane Status Light | <ul style="list-style-type: none">• Automatic Lane Barrier• Power Supply Unit & Solar Panels & Backup Systems (Batteries)• Communication Network Civil Works (Ducting, Manholes), Laying of the Fiber Optic Cable & Installation of the Communication Equipment along the Road Section & Buildings. |
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Plaza Level Hardware

- Oracle DB and Linux Web Server
- Work stations

Data Center Level Hardware

- Main Oracle DB and Linux Web Server
- Disaster Recovery System (DRS)

Toll Collection System (E-Fast Lanes)

The RFID system uses RFID tag and RFID reader which collects information of vehicle passing through the toll plaza and automatically debits the toll amount from prepaid account of vehicle owner, which in return reduces the traffic congestion and human errors. The vehicle owner has to register his vehicle with provided RFID tag, creating a rechargeable account. When the vehicle will pass through toll gate the amount of toll will automatically be reduced

from its account.

Toll Collection System (E-Tag Lanes) Hardware comprises of three levels

- Lane level
- Plaza level
- Data Center Level

Lane Level Hardware

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| <ul style="list-style-type: none">• Booth & Booth PC• Industrial Grade Keyboard• Printer• Lane Controller• Lane Controller• RFID Reader• E-Tag | <ul style="list-style-type: none">• Fare Display Unit• Automatic Vehicle Classification (AVC)• Lane Vehicle Image Capture Camera• Plaza Incident Video Camera• Lane Traffic Light• Lane Status Light• Automatic Lane Barrier | <ul style="list-style-type: none">• Power Supply Unit & Solar Panels & Backup Systems (Batteries)• Communication Network Civil Works (Ducting, Manholes), Laying of the Fiber Optic Cable & Installation of the Communication Equipment along the Road Section & Buildings. |
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Fast Lane Management (ETC)

1 Entry / 1 Exit Lane = Each Interchange



A Centralized Electronic Toll Payment service that enables fleets to take advantage of high-speed, cashless toll lanes with or without an in-vehicle transponder. With its centralized controls, reporting and payment processing, Fast Lane does for tolling what fuel cards have done for fuel management.

The Plaza level, Control Room Level & Data Center Level Hardware are same as toll collection system (Man Managed Lanes).

Software for Toll Collection System (TCS)

Toll Collection System (E-Tag Lanes) Software comprises of three levels.

- Lane Level
- Plaza Level
- Data Center Level

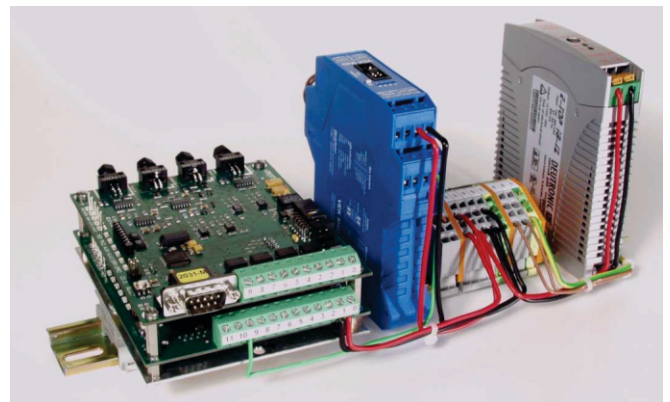
- Supervisor override functions such as manual barrier opening
- End-of-Job Summary Print-Outs (Optional)
- Automatic uploading of unsent data after recovery from LAN or Server failure
- Incident Recording
- Incident-Triggered Lane Video Capture
- Acceptance of Operating Parameters from Plaza / Central Computer
- Diagnostics or Maintenance Mode

Toll Plaza Software

- Serve as a Collection point of all data and video images from the Lane Controllers
- Provide Real-Time Monitoring function for the status of all the lanes
- Perform Toll Operator Accountability
- Serve as a Gateway to the Central Computer System

Toll Collection Lane Software

- Log-in & log-out functions of Toll Operator & Supervisor
- Toll Operator User Interface for Transactions and Lane Operations
- Receipt Printing
- Payment Device Interface for Magnetic Stripe Card, Contactless Smart Card or ETC Tag
- AVC Interface to determine Vehicle Class using Lane Sensors
- Transaction Recording in Lane Controller & Plaza Computer
- Lane Equipment Control for Barrier, Traffic Lights, Toll Fare Indicator, etc.



Central Server Software

- Main Database Server & Back-Up Server
- Consolidate all Data & Video Images from Different Toll Plazas
- Display Live Video from any Lane of any Toll Plaza
- Generate Consolidated Reports - Traffic, Revenue, Incident, Card History, etc.
- Manage Operating Parameters & Lane Configurations of Toll Plaza Equipment
- Perform Audit Functions
- Perform Card Redistribution & Processing Functions
- Perform ETC Tag Reload, Issuance and Account Management Functions
- Provide Web-based Access on a Read-Only Basis
- Commuters will receive SMS alerts on his registered mobile numbers for all the transactions done in his tag account
- Online Recharge: Customer may recharge his tag account online through, Credit Card / Debit Card / Web portal or Net Banking.
- No need to Carry Cash: Customer doesn't need to worry about carrying cash for the toll payments
- Web Portal for Commuters: Patrons can access their statements by logging on the web portal.

Benefits of Toll Collection Systems (TCS)

- 24 hour reliable operation under heavy traffic.
- **Operating Cost Saving:** Full automatic operation reduces personnel requirements.
- **Congestion Reduction:** Reduced toll transaction times increases lane capacity and decreases queues formed in front of toll lanes.
- **Vehicle Theft Detection:** When vehicle is stolen the owner registers complaint on the website with its registration ID and unique RFID tag number. Now when stolen vehicle passes by the toll plaza, the tag fixed on it is matched with the stolen vehicle's tag in the database at the toll booth.
- Automatic operation reduces fraud risks by eliminating cash transactions and interaction with toll collectors.
- Integrated toll system management for a country-wide operation.
- Automatic Vehicle Classification (AVC) where vehicle classes may be defined according to the administration's requirements.
- Automatic Number Plate Recognition (ANPR), in order to digitally capture license plates.
- System integrates all functions required for a complete operation: card formatting and personalization, card replenishment, toll collection at the lanes, station-level and higher-level management centers, centralized data base for transactions and customer accounts, violation processing and customer support terminals.
- **Emission Control:** Less emissions in toll area and no infrastructure cost is required.
- Commuters will receive SMS alerts on his registered mobile numbers for all the transactions done in his tag account.
- **Online Recharge:** Customer may recharge his tag account online through, Credit Card/ Debit Card/Web portal or Net Banking.
- **Enhanced Cash Handling:** Customer doesn't need to worry about carrying cash for the toll payments.
- **Web Portal for Commuters:** Patrons can access their statements by logging on the web portal.
- **Enhanced Data Collection:** Information such as vehicle count over the time of the day, date, time etc can be obtained due to the deployment of this technology. This helps in making decisions regarding the pricing strategies for the toll providers. It also helps planner to estimate the travel time that aid in designing decisions.
- **Incident Reduction:** It is observed that there is reduction in the number of incidents caused near the toll plazas With all these benefits, it is evident that there exists a lot of opportunity of research in studying the impacts of these benefits over the ETC lanes. This research will address all the quantifiable components of the benefits on the integrated basis.

