Automatic Fare Collection System (AFCS) in India

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Abstract: *Road infrastructure in a country is one of its lifeline, which requires continuous development and maintenance. The concerned authorities [Figure 1] for toll plazas and roadways development in India are MORTH (Ministry of Road Transport and Highways), NHAI (National Highway Authority of India) and SHA (State Highway Authorities). After decades of social and technological development, the first RFID (Radio Frequency Identification) based AFCS (Automatic Fare Collection System) in India was implemented on the Ahmedabad-Mumbai National Highway in April 2013. Continuous development led to the implementation of RFID based AFCS in 2014 (named as FASTag). However, due to various factors including lack of awareness, resources and other factors, the target of 200,000 AFCS users till March 2017 fell short. The current status of the RFID based AFCS (FASTag) in India is still below the required level of implementation as each toll plaza having 10 or above lanes only has 1 or 2 FASTag lanes installed This research encompasses the issues and challenges faced by the commuters as well as the authorities regarding the current state of the Indian toll plazas and how RFID based AFCS can benefit them. For this, surveys and interviews were conducted with commuters and toll plaza operators.*

Keywords: AFCS, RFID, FASTag, Toll plaza

1. Introduction

The entire network of road in India amounts to 3.346 million kilometers [Table 1] in length which is 2nd after USA. National highways and expressways constitute only 2.9% of the entire road network, however they carry approximately 40% of the total road traffic (including passenger and freight traffic). Therefore, management and development of national highways is important for the India government.

Table 1: Classification of Indian Roadways

Road Type	Length (km)	% of Network
Expressways	200	0 (0.006)
National Highways(NH)	96,260.72	2.9
State Highway(SH)	131,899	3.9
Major District Roads	467,763	14
Rural & Other Roads	2,650,000	79.2
TOTAL	3346122.72	100

For further funding the development and maintenance of the India road network, government levies tax, known as toll tax [Table 2 & Table 3] on the vehicles. These taxes are collected at specific payment locations on the road known as toll plazas [Table 4]. Matters related to national highways, for instance maintenance, development, management, toll tax collection and policy regulation are handled by NHAI. The authorities release tenders to outsource construction, maintenance and operations of toll plazas to private companies for certain period of time (determined by the investment and the traffic at that location).

The current methods of toll collection include cash transactions, fleet card, e-wallet payment & RFID based AFCS. According to the NHAI, the number of vehicles in India has increased at a rate of 10.16% per annum over the last 5 years. As a result, the current processing capacity of the pre-installed toll plazas falls short to meet the increasing

demand, thus causing traffic congestions and increase in waiting time. For this purpose, new and efficient methods of toll collection are being proposed and implemented across India; FASTag being one of them.
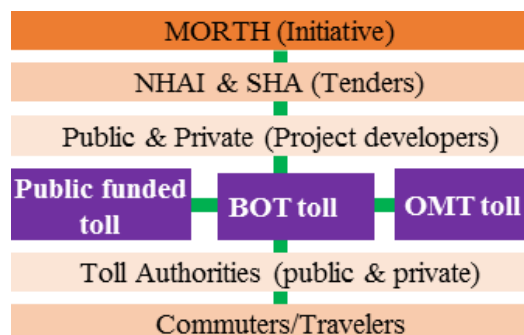

Figure 1: Toll authorities and stakeholders

Note: NHAI provides a free pass to commuters if the waiting time in queue and the transaction time at the toll plaza is more than 3 minutes. However due to lack of infrastructure at some toll plazas, this is not being implemented as expected.

Table 2: Toll tax base rate for different types of vehicle

Vehicle Classification	Toll tax base rate (INR/km)
Car/Jeep/Van	0.40
LCV (Light Commercial Vehicle)	0.70
Bus/Truck	1.40
Up to 3 Axle	2.25
4 to 6 Axle	2.25
HCM/EME (Heavy Construction Machinery/Earth Moving Equipment)	2.25
7 or more Axle	2.25

Table 3: Classification of toll concessions

Toll Classification	Validity
Single journey (one way)	None
Return Journey(two way)	24 Hrs.
Monthly Pass(multiple)	30 Days
Commercial Vehicle Registered within the district of Plaza	none

Table 4: Classification of Toll Plazas

Toll Classification Validity
Public funded
BOT (Build-Operate-Transfer)
OMT (Operate-Maintain-Transfer)

2. Issues Faced

In the current scenario of toll tax collection methods, multiple issues are faced by the authorities and the travelers. The degree of these issues vary from one location to other due to varying factors such as size of the toll plaza, processing capacity, traffic density at the toll plaza, employee efficiency and system efficiency.

2.1 By Indian Government

2.1.1. Toll frauds
Toll frauds in India include travelers seeking unauthorized exemption from paying the toll tax and the companies which create false reports of toll collected. This affects the toll tax rates and the revenue margin of NHAI all over India.

Unlawful exemptions
MORTH has issued directives which exempts specific vehicles from paying the toll tax. Vehicles carrying state and central government officials on duty fall under this category. On 3rd December 2010, Indian government had tendered a notification stating that the exemption is available only for NHAI or any other government organization using such vehicles for inspection, survey, construction or operation of national highways and maintenance. However, certain anti-social elements specially the localities sometimes take advantage of this and refuse to pay the toll, which creates a temporary disturbance in the operational activities of the toll plaza in the form of traffic congestion.

Unreliable reporting
Unreliable reporting of toll plazas refers to the inaccurate or misleading revenue reports which is submitted to NHAI for audit. It is done to gain extra profits and extend their tolling period. As a result, NHAI loses a part of its revenue earnings which could be utilized for further development of the roadways.

CASE-1: In the Indian capital city New Delhi, the Hon' Supreme Court had ordered to waive off the toll collection at DND flyway pending auditing of Noida Toll Bridge Company Limited (NTBCL). Charges of excessive and unlawful tolling has been filled against the company in 2012. It is estimated that nearly 150,000 vehicles pass through that toll on a regular basis and the toll for both ways is INR 56 (Indian National Rupee), making it up to a toll collection of INR 8.4 million per day. According to authorities, NTBCL has recovered more than twice the amount as compared to the cost of the project which was INR 4.08 trillion.

2.1.2. Employee safety
The majority of toll transactions in India are cash based which causes large amounts of cash to be accumulated at toll plazas. This further creates a scenario where it is possible for the anti-social elements to cause damage in the form of robbery or theft. Such scenarios pose a threat to the safety and security of the toll employees. These situations arise because of cash collection and cash management. Many of these incidents get neglected or go unreported in India. Especially the toll plazas which are located in the outskirts, far from a bank or a police station.

Case-2: An armed robbery at a toll plaza in India presented itself on 27th April, 2017, in which two youths looted INR 10,000 at gunpoint from the Ropar, Punjab toll plaza at 2 am.

2.1.3. Maintenance and serviceability
The average processing time of a cash transaction is 30 seconds (excluding waiting time), which results in maximum processing capacity of 120 vehicles per hour. This reduces the serviceability of the toll plazas during peak hours when the rate of incoming vehicles is more than the processing capacity. The components involved in the cash transaction system are more prone to errors and faults due to the outdated nature of technology.

Case-3: The routine maintenance of Shahjahanpur on Delhi-Jaipur Expressway Toll Plaza costed around INR 2.31 million and took 3 months of contract time to complete in 2008.

Taking an average of INR 2 million for maintenance of each toll plaza. The government spends around INR 860 million on 430 toll plazas across India just for maintenance. This creates a negative impact on the revenue margin for toll projects.

In India, post demonetization, the toll plazas were exempted from collecting toll tax from 9th November to 2nd December, 2016. This was due to the high dependency on cash transactions and lack of alternate mode of payments at many of the toll plazas, hence reducing the serviceability by a huge margin.

2.1.4. Cash management
More than 90% of the toll payments are still cash based transactions instead of digital payments, which are more safe and reliable at a toll plaza. As a result, they handle thousands and millions worth of cash on a regular basis. Cash management becomes an issue at the toll plaza because the capability to tender exact change decreases as the number of passing vehicles increases. Due to this the waiting time at the toll plaza increases. The cash collected by levying toll tax is to be transferred to a registered bank which is located far away from the toll plaza. Therefore, it is done only once or twice in a day.

2.1.5. Traffic management

Current design and methods of toll plazas and collection systems create a lot of traffic congestion. Due to the undedicated nature of these lanes the traffic management is affected. Since different taxation policies and rates apply to different class of vehicles, the toll plaza employee has to change the format of taxation which consumes time. Due to the traffic congestion and waiting time, some travelers tend to change lanes in the midst of moving traffic, thereby increasing traffic congestion and causing road rage.

2.1.6. Environmental and health concerns

A study conducted by the ICMR (Indian Council for Medical Research). The calculated concentration of PM2.5 (Particulate Matter) at the Highway toll plazas and the municipality tolls had an average of 150ig/m3 and 219 ig/m3 respectively. The minimum reading noted at a municipality plaza was 140 ig/m3 which is still more than double the permissible limit of 50 ig/m3. The PM2.5 causes lung tissue inflammation and changes blood chemistry while increasing susceptibility to viruses and bacterial pathogens.

Exhaust fumes, nearby industry emissions and direct exposure to pollutants is an environmental and health concern. Maximum exhaust emissions are released when a vehicle slows down and pays for the toll and then accelerate again. The toll plaza workers work in a confined enclosed booth, where they are exposed to these emissions all day. These emissions come from various vehicles passing through the toll plaza or are waiting in line at the toll plaza. The average burning rate of fuel for an Indian car is approximately 1lt/hr. These fumes contain Nitrogen Oxide (NOx) which affects the respiratory and immune systems. [Table 5]

Table 5: Health implications of Vehicular Pollution

Acute Exposure to NO2	Clinical effects of NO2
respiratory irritation	shallow respiratory rate
pulmonary oedema	rapid heart rate
pneumonitis	wheezing
bronchitis.	cyanosis.

2.2 By Travelers

2.2.1. Cash availability

The major share of income comes from cash transactions at the toll plazas. The availability of cash at toll booths and with the traveler has been a matter of concern because there is no fixed denomination to be paid. The annual growth rate of vehicles on road has been 10.16% for the last 5 years but the processing capacity and faster methods of payments at toll plazas are not matching with the pace.

Commuters still prefer cash as the primary mode of payment [Table 7], which results in sustained issue of cash availability. Lack of knowledge & information regarding benefits and implications of AFCS has affected the growth rate in alternate modes of payments. The research conducted through the survey depicts that approximately 62.4 % [Table 6] commuters have suffered cash/change issue at least thrice in their last 10 visits to toll plazas. This issue results in increased waiting time and traffic congestion which decreases the efficiency of toll plazas and also turns the purpose of the toll roads moot.

Table 6: Degree of cash issue

Instances	Cash/Change Issue
0-2	37.60%
3-5	35.10%
6-8	14.30%
9-10	13%

Table 7: Dependency of commuters on different modes of payment

Congestion (out of 10)	% suffered
0-2	13
3-5	39
6-8	33.8
9-10	14.3

2.2. Waiting time (traffic congestion)

The waiting time at the toll plazas has been one of the major issues for the commuters. This results in traffic congestion at the toll plazas. The resulting traffic congestion leads to excessive fuel consumption which raises monetary and health/environmental issues.

Due to this the travelers are forced into lane cutting, road rage and illegal exemptions. The survey revealed that majority of the commuters suffer from traffic congestion at the time of their visit to toll plazas. Whereas only 13% of the commuters suffered minimum congestion. [Table 8].

Table 8: Degree of traffic issue

Payment mode	% users
Cash	40.3
Card(debit/credit/fleet)	13
Online (net-banking)	0
E-Wallet(PayTM/Mobiwik)	24.7
Dedicated Tag: FASTag	22.1

2.2.3. Road rage (lane cutting)

Road rage is the resulting effect of increased waiting period caused by factors like cash availability and toll/toll employee issues at the toll plaza. According to the survey [Table 9], majority of travelers have suffered or witnessed lane cutting and road rage while waiting at toll plazas. Hence raising the issue to a higher level of inconvenience. Due to the resulting road rage and lane cutting, the waiting time further increases at the toll plazas.

Table 9: Degree of road rage

% witnessed/suffered	No. of instances
32.5	0-2
31.2	3-5
28.6	6-8
7.8	9-10

2.2.4. Other issues

Factors such as shift change (system handover), system error (software or hardware malfunction), no electricity fluctuations among others. can also affect the functioning of

the toll plazas. Majority (59.7%) of the survey population have rarely witnessed such issues however with the current technology and functioning these issues should be near zero but they still continue to exist [Table 10] and affect the road transportation and the toll plaza systems. This further enhances the degree of afore mentioned issues.

Table 10: Degree of toll plaza issues

Instances	% suffered
0-2	59.7
3-5	28.6
6-8	7.8
9-10	3.9

3. AFCS: A Solution for Indian Toll Collection System

3.1 Introduction

AFCS stands for AUTOMATED FARE COLLECTION SYSTEM, it is a technologically advanced smart solution for transportation systems which require instant fare collection and in large numbers. AFCS enables a traveler to pay for the transport mode via a debit/credit card, RFID tag, smart card and online portal. Due to multiple payment options, the time taken for the transaction to take place is significantly less compared to the cash based transactions. The presence of multi modal payment options enables the commuter to make payments in public mode of transportation like metro, buses and trams which is highly convenient for commuters in public transport. However, toll plazas in India are one of the areas where the application of AFCS (FASTag – September 2014) has not been optimum when compared to the potential it holds.

Case 4:
Kerki Daula (BOT toll)
NH-48, Delhi, India
Stretch: Delhi-Gurugram

Commercial operation date: 25th January 2008
No. of lanes: 25   FASTag lanes – 6 (Undedicated)
Average number of vehicles passing through: 80,000
Avg. no. of vehicles passing through with FASTag: 2000
% of vehicles using FASTag: 2000/80000*100 = 2.5%

3.2 Structure of RFID based AFCS

3.2.1 Components
Vehicle
As mentioned earlier in the table, vehicles are classified according to their axle count, utility, weight, travel frequency and place of registration. Vehicles passing through a toll booth can range from a small car to a giant bulldozer. [Figure 2]
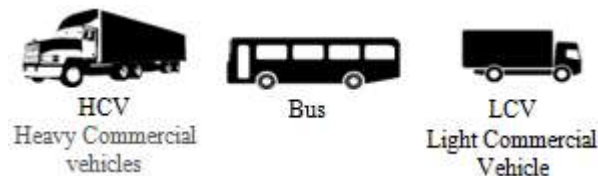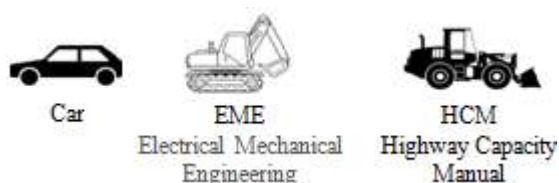

Figure 2: Vehicle classification

Speed breakers
The purpose of speed breakers is to slow down the incoming vehicle so as to allow the RFID scanner to scan the Tag installed on the vehicle. The speed breakers can be of two types: speed bump or speed hump. [Figure 3]

Figure 3: Types of speed breakers

Dedicated lane
The lanes in the toll plaza will be dedicated in nature i.e. there will be certain criteria for a vehicle to be eligible to enter that lane. In retrospect, the lanes will be classified based on the vehicle type. There can exist a dedicated lane for car, bus, truck, HCM/EME, 3 axles and above.

RFID tag & scanner
The RFID tag and scanner are infrared technology based equipment which allows the AFCS to exchange data on the dot. An RFID tag comes with a small microchip embedded in the center of the tag along with an antenna attached to the tag for detection purpose. The microchip contains encrypted information which has been already programmed by the issuing authority.

RFID tags can be Active RFID tags which require a power source to emit transmission and have a range of nearly 300 feet or Passive RFID tags which do not require a power source and having a detection range of approximately 10-30 feet, depending on the range of frequency they are using. The Passive RFID tags for AFCS work on an ultra-high frequency band of 300MHz to 3GHz. [Figure 4(a)]

Figure 4(a): Types of RFID tags

The device which detects an RFID tag and decrypts the information stored in the RFID tag is called a RFID scanner. The scanner emits a low electromagnetic field which is powerful enough to operate in a limited area only. When a vehicle enters a dedicated lane then the electromagnetic field is picked up by the antenna of the RFID tag

It responds back with the encrypted data transmission which is then picked up by the antenna inside the scanner system. As soon as the scanner picks up the transmission, it decrypts

the data internally using decryption algorithms installed as per requirement. The RFID scanner can be hand-held or stationary. [Figure 4(b)]
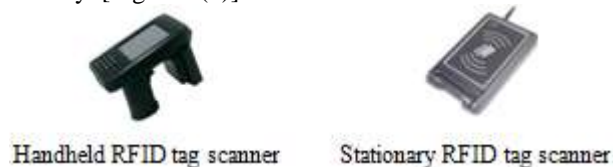

Figure 4(b): Types of RFID scanners

Camera

The camera installed at the toll booth is for security function as well as for the toll booth operator to visually confirm the information received from the RFID tag and the vehicle on which it is installed. The second purpose of the camera is to simultaneously transmit the feed to the remote server for storage and retention purposes. There are multiple types of security camera available. The type of camera chosen depends on the design and requirements of the toll plaza.

Employee & employee system

The employee system is a stationary desktop which is used to complete two tasks:
1) For visual confirmation (matching information from the RFID tag and the vehicle)
2) For displaying and processing of the RFID scanner information (toll tax transaction)

The monitor screen [Figure 5] displays real time feed from the security camera for visual confirmation and transaction request for toll collection. It is done in a step by step manner:

Step 1: The employee visually confirms the authenticity of the vehicle as per the information received from the RFID tag installed on the vehicle

Step 2: After visual confirmation the employee then forwards the transaction request to the remote server.

Step 3:
(a) When the transaction is successful, the toll employee (or system) opens the boom barrier to allow the vehicle to pass.
(b) When the transaction is rejected, the toll employee engages the vehicle driver in a cash based transaction or other modes of payment

Step 4: After successful payment of the toll, the employee or system then opens the boom barrier to allow the vehicle to pass through

Information network

The whole structure of toll plaza is a series of information network interconnected to each other via networking protocols like Ethernet, Wi-Fi or satellite connection [Figure 6], whichever is suitable as per the requirements and budget of the toll plaza. The connected components are RFID scanner, camera, employee system, the boom barrier [Figure 7] and remote server [Figure 8].
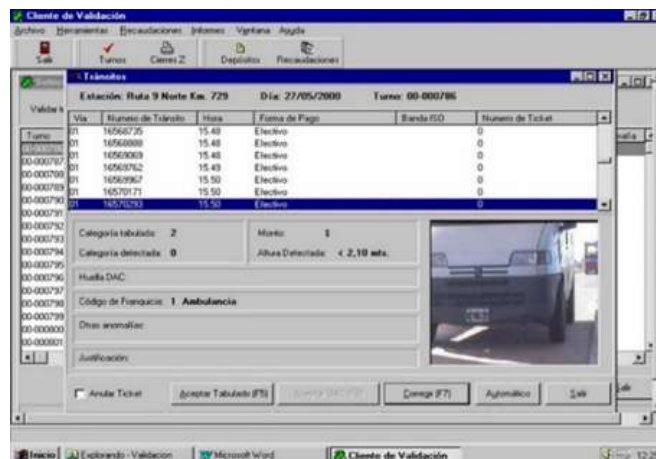

Figure 5: Typical AFCS work station

Figure 6: Various Networking Methods

Figure 7: Boom Barrier

Figure 8: Backend Serve*r*

Backend server

The remote server's task is to process the transaction and store the data for record keeping. The final transaction occurs at the remote server where initially the request is processed and then the required amount is deducted from the registered RFID tag account. RFID tag account is an account created by the RFID tag user after registering his/her vehicle with the designated authorities. The user can transfer funds in this account to pay the toll taxes via AFCS.

If the account has insufficient funds, then the server prompts the toll booth employee to collect cash or engage in other modes of payment to resolve the issue. After processing the request, the server transmits the result to the employee system. The response from the server can be of three types: transaction successful, transaction failed and system error.
The second purpose of the remote server is to store the security feed obtained from the camera for internal or security purposes.

Boom Barrier

The purpose of the boom barrier is to stop a vehicle from crossing a toll booth in case of a failed transaction or in case the vehicle driver refuses to pay the toll and may try to force his/her way out.

3.2.2 Software Architecture

All the physical components of a standard AFCS are interconnected via a software [Figure 9] which forms the lifeline of the AFCS. The networking efficiency of the system depends partially on the software efficiency because in case of AFCS, the transaction occurs at the server for which the employee system delivers the transaction request. All the transactions and processing request involved require a reliable software interface for efficient working. All the information is stored within the server and only the server has the access to edit the information. All other components are granted only read access from the remote server. This increases the reliability of the transaction records and the system as a whole.
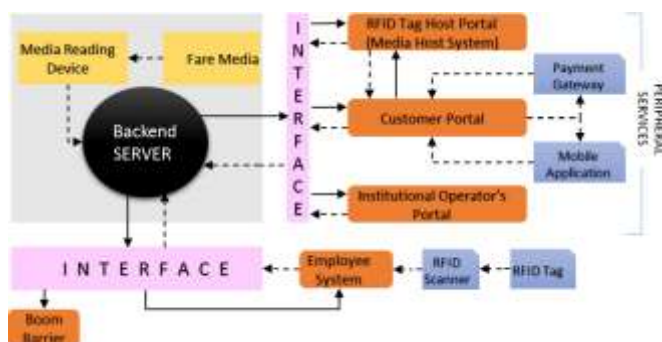

Figure 9: Software Architecture of a standard RFID based AFCS

Fare Media: For RFID based fare collection, Fare Media refers to RFID. However, other non RFID media can also be supported e.g. Fleet card, QR token etc.

Media Reading Device: These are devices to read the media (RFID or other medias) and pass the media information to backend system.

Backend Server: The main function of backend server is to validate the generated payment request and keep a log of the transactions. It serves as the primary database for all the AFCS subscribers with individual customer ID allotted to each one of them. The security camera recordings are also stored at the primary server.

Interface: It refers to the software program which enables two components to interact with each other. The specifications of the interface depend upon the operational model and the business plan opted by the authority overseeing RFID based AFCS.

Peripheral Services: It includes all the online portal services which are hosted at other servers, such as

RFID Tag Host Portal – Portal for hosting the RFID or other fare media related information and services.

Customer Portal – To recharge customer account/media balance, to check the balance, to list the customer transactions. It also provides other services such as latest news & information regarding toll plazas, mobile application and payment gateway for the subscribers is provided via this portal.

Institutional Operator's Portal - Toll plaza operators use this portal to remain in contact with the toll authorities and to obtain latest news and information.

3.2.3 Working

AFCS can be easily implemented by simple installation of the given hardware components in an orderly fashion. When implemented the AFC system will follow certain steps to complete its process of fare collection. The outcome can be explained in two cases: CASE 1-transaction is successful and CASE 2-transaction is rejected. There is no other possible outcome in the given scenario. The step wise diagrammatic explanation is given below:
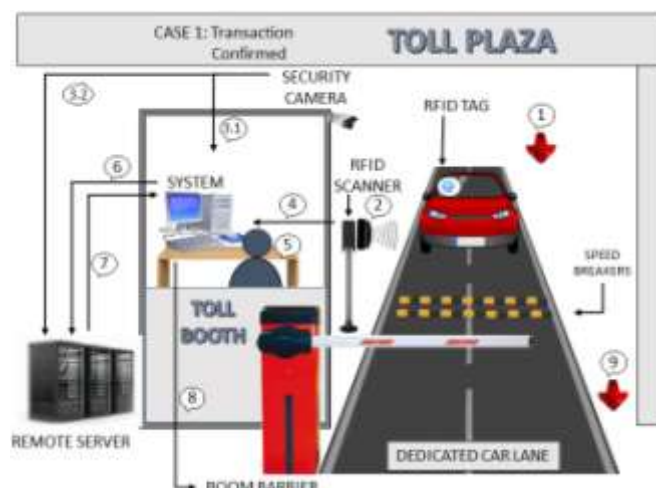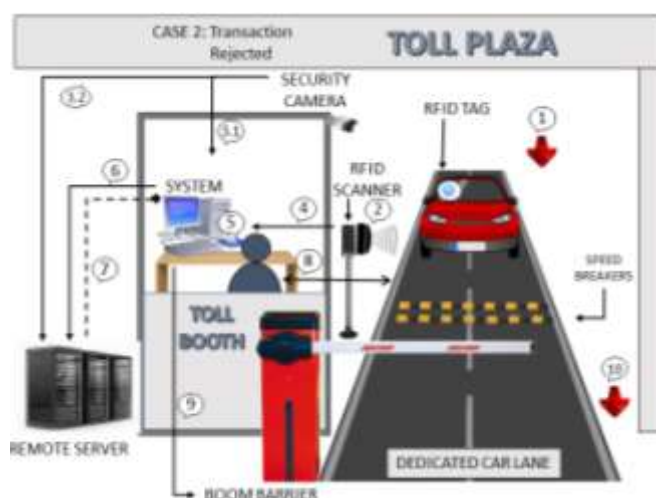

Figure 10: CASE 5-Transaction successful

Figure 11: CASE 6-Transaction rejected

CASE 5 (Transaction Confirmed) [Figure 10]
Steps involved:
1) Vehicle enters the toll booth area and slows down before hitting the speed breakers.
2) The RFID scanner installed after the speed breakers scans the RFID tag installed on the vehicle as it slows down before the speed breaker.
3) The security camera installed at the toll booth forwards the security feed to two places:
   a) The toll booth employee system.
   b) The remote server.

4) The RFID scanner transfers the scanned information from the RFID tag to the employee system.
5) The toll booth employee then makes a visual confirmation of the information received and forwards the transaction request to the remote server using the computer system.
6) The remote server then processes the request for transaction.
7) After processing the request, the server communicates the output to the employee system i.e. transaction is successful and simultaneously it sends a text to the registered mobile number of that vehicle about the details of transaction and the balance amount.
8) After confirmation of the transaction, the toll booth employee or the system opens the boom barrier.
9) As the boom barrier opens the vehicle exits the toll booth area.

Note: Step 2 to step 8 are occurring when the vehicle is travelling the distance between the speed breakers and the boom barrier i.e. the vehicle is in continuous motion.

CASE 6 (Transaction Rejected) [Figure 11]

Steps involved:
1) Vehicle enters the toll booth area and slows down before hitting the speed breakers.
2) The RFID scanner installed after the speed breakers scans the RFID tag installed on the vehicle as it slows down before the speed breaker.
3) The security camera installed at the roof of the toll booth forwards the security feed to two places:
   a) The toll booth employee system
   b) The remote server
4) The RFID scanner transfers the scanned information from the RFID tag to the employee system.
5) The toll booth employee then makes a visual confirmation and forwards the transaction request to the remote server.
6) The remote server then processes the request for transaction.
7) After processing the request, the server communicates the output to the employee system i.e. transaction is REJECTED along with the reason, simultaneously it broadcasts a text to the registered mobile number of the vehicle regarding the reason it was declined and the solution for the problem.
8) After rejection of the transaction, the toll booth employee engages the vehicle driver for a physical transaction (cash, card or e-wallet).
9) As soon as the physical transaction is complete, the toll booth employee opens the boom barrier by pressing a button.
10) As the boom barrier opens the vehicle exits the toll booth area.

Note: Step 2 to 7 are occurring when the vehicle is travelling the distance between the speed breakers and the boom barrier, but the vehicle has to stop for the physical transaction at the toll booth.

4. Real World Implementation and Outcome

Since the onset of motorways in early 1960s, the development of toll plazas has been rapid. World over the tolls have been a source of huge investments for improvement in existing road network and development of new ones. Issues like user safety, travel comfort and environmental pollution have been tackled over the decades with the help of toll systems.

Single lane tolling system are those where the highway is divided into separate lanes by construction of toll booths. They can be manned and unmanned based on technology used for toll collection. Travelers have to either stop or slow down to make payments.

Free flow tolling system does not require toll booths or dedicated lanes. This type of tolling system is unmanned and it allows the travelers to make payments while traveling at normal speeds (no stopping or slowing down). The only mode of payment available at these toll plazas are non-interactive toll payment systems like RFID based AFCS. It is more complex and high maintenance than single lane tolling system but it provides a direct and uninterrupted path without any traffic.

Countries like France and other southern European countries like India, Spain, Italy and Portugal have implemented the single lane system. Whereas, the free flow system is predominantly used in countries like USA, Australia, Canada, Israel and Chile. In both the systems the data is exchanged between the scanner and the RFID tag on the vehicle and the transaction occurs automatically.

In 2000 France started an initiative called TIS (Télépéage Inter Société) in which all toll operators started offering their users identical microwave tags (working frequency – 5.8 GHz) which can be used at any toll plaza within France. In 4 years the number of subscribers reached 1.2 million.

Similarly, in February 2003, London implemented an Urban Taxation System which was aimed at reducing the traffic congestion in city center by 15% and the method used is free flow system of tolling.

The implementation of AFCS in other countries resulted in a processing speed of 500 vehicles in one hour in single lane system and an outstanding number of 1800 vehicles in free flow with an error rate of .01%. Whereas the conventional systems offer maximum of 200 transactions per hour (error free). As a result, the rate of toll collection and traffic management in these countries is higher.

Note: All FASTag users get monthly cashback of 10% in their registered FASTag account of toll tax paid in that month.

5. Benefits

5.1. Economic impact

AFCS enables the government to collect toll tax from every vehicle it is applied on. It helps in increasing the revenue from the toll plazas by reducing illegal toll jumping and unlawful exemptions. Some AFCS do not require operators, hence removing the need for employee systems and the cost that comes with it.

CASE 7: On 8th November 2016, Indian government declared demonetization of INR 500 & INR 1000 currency and introduced new INR 500 and INR 2000 currency. This created an unexpected shortage of cash. Even the toll plazas were not exempted from this situation, from November 9 to December 2 2016, NHAI suspended the collection of toll tax at the plazas which caused the concessionaires a huge loss of INR 12.12 billion, out of which NHAI paid INR 9.22 billion for compensation regarding the toll tax suspension. The solution for this is to have properly digitized and alternate methods (digital payments) were available. AFCS enables the toll plazas to go cashless in case of such emergencies which will prevent monetary loss to the government and the toll companies.

Case 8: An example can be taken by considering the paper receipts toll plazas use on every transaction:

Cost of 1 paper roll – INR 30
Length of 1 paper roll – 25m
Average no. of cars served using one roll – 200
Assuming the number of cars crossing toll plaza per day - 100,000

Therefore,
No. of rolls used in one day = 100,000/200 = 500
N**o. of rolls used in one year** = 365*500 = 182500
Annual cost of paper rolls = 182500*30 = INR 5.475 million

It implies that for one toll plaza INR 5.475 million is spent only on paper receipts, which is not a primary expense and can be reduced by huge margin as AFCS does not require a paper receipt.

5.2. Public & employee safety

Reducing the number of illegal jumping and unlawful exemptions, coupled with 24x7 surveillance with proper backup systems will also increase the traveler's as well as employee safety.

As per the survey conducted, we found that safety was not the primary concern as in regards to the travelers, whereas the toll employees have different approach to safety as they have the responsibility for cash management and cash transfers which sometimes, although rarely, attracts crime.

5.3. Reliable & efficient

According to the interviews conducted with the toll operators, FASTag lanes are highly efficient. They can run 24x7 without stopping and requiring any breaks, which increases the serviceability of the toll plazas and helps in swift and accurate tolling procedure. In case the server goes down then rebooting procedure can be completed in under a minute. Due to the unique nature of components involved in FASTag, any one of them can be replaced in case of damage or breakdown, without affecting the system as a whole

5.4. Increase passenger flow

The TCI (Transport Corporation of India) provides integrated multimodal logistics services. In 2014-15 they published a report mentioning an annual cost of INR 6.6 billion for the Indian economy due to delays in road transport (traffic at the toll plazas and increased waiting time for the transactions). They saved USD 14.7 billion because of enhanced fuel efficiency from 9.6 million freight carriers. Every year the freight carriers try to reduce their transportation cost occurring due to delays and excess fuel consumption at the toll plazas.

The reduced processing time and nonstop tolling by the use of AFCS will enable in reducing the waiting time to a few seconds. Factors such as presence of dedicated lanes and the ease of use will reduce delays and waiting period.

5.5. Auditability

All the toll plazas present on national highways in India are subject to yearly audit by the NHAI. The main problem suffered by NHAI is the false reporting of the transactions by the toll operating companies. The companies sometimes take advantage of and report false transactions in order to extend the PPP (Public Private Partnership) contract and gain higher profits from the travelers.

AFCS will remove any sort of unnecessary means to gain any profit at the expense of the citizens. Due to the digitized transactions, the reports will be 100% accurate with limited access to the remote server, the reports cannot be tampered hence preventing reporting errors. Additional feature of backing up of transactions to another backup server will provide an additional layer of security to the transaction reports.

This will allow the government to earn their deserved revenue from the toll plazas and will enable the PPP contracts to end on time.

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