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by Dr Harold Worrall & Dan Faust

ALL-INCLUSIVE FOCUS

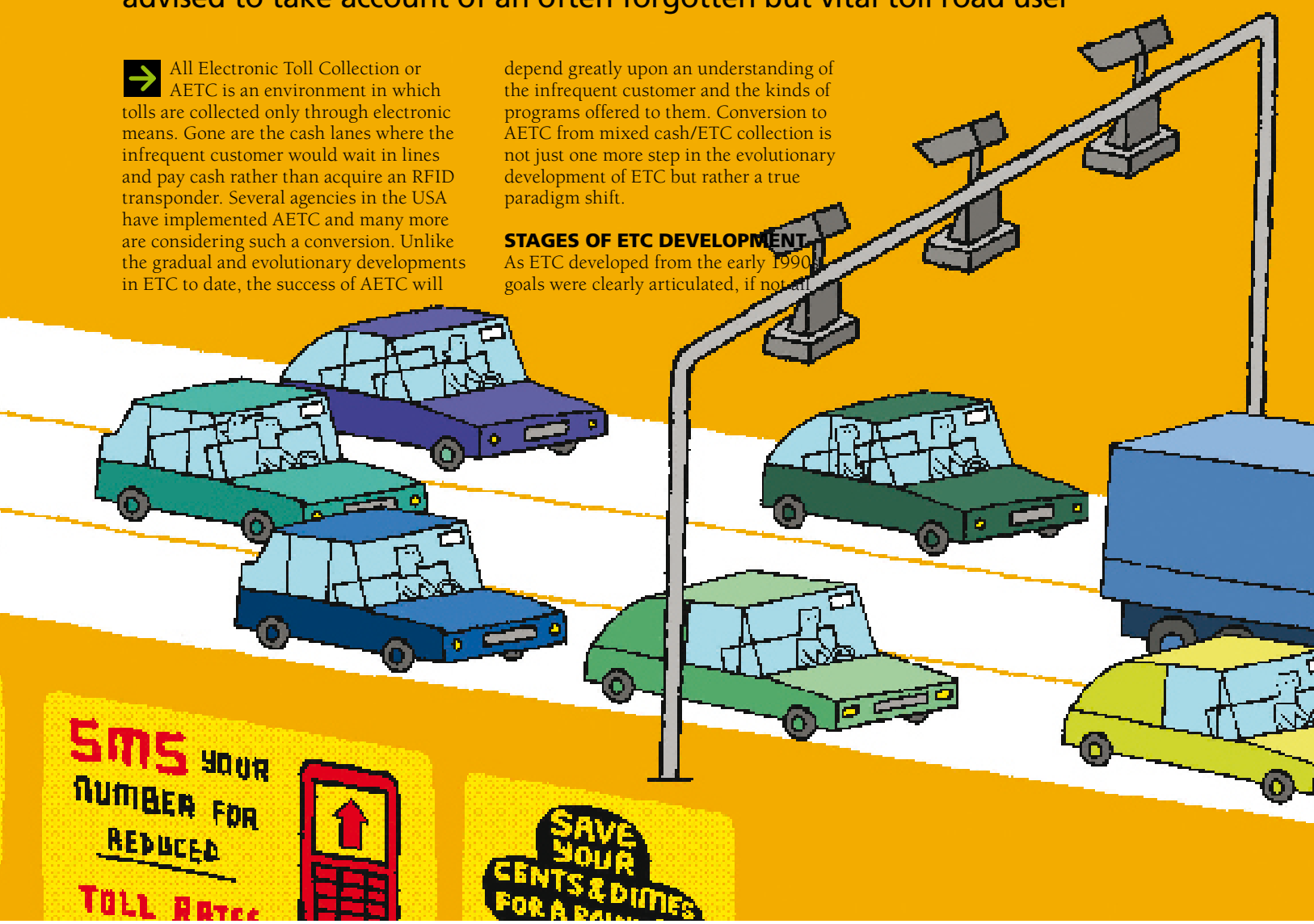
THE PARADIGM OF THE INFREQUENT CUSTOMER

With the move toward all-electronic toll collection, agencies would be well advised to take account of an often forgotten but vital toll road user

All Electronic Toll Collection or AETC is an environment in which tolls are collected only through electronic means. Gone are the cash lanes where the infrequent customer would wait in lines and pay cash rather than acquire an RFID transponder. Several agencies in the USA have implemented AETC and many more are considering such a conversion. Unlike the gradual and evolutionary developments in ETC to date, the success of AETC will depend greatly upon an understanding of the infrequent customer and the kinds of programs offered to them. Conversion to AETC from mixed cash/ETC collection is not just one more step in the evolutionary development of ETC but rather a true paradigm shift.

STAGES OF ETC DEVELOPMENT

As ETC developed from the early 1990s goals were clearly articulated, if not all



accomplished. Such aims included increased toll plaza throughput without the expense of expanding toll plaza capacity. They included lower operational costs, increased convenience for the customer, as well as increased toll revenue resulting from less toll plaza congestion. They also included expanded policy options for transportation revenue and congestion management.

From 1990 through to the present day, ETC has evolved in stages. In its early guises, cash was accepted in the same lane with ETC, while enforcement was provided with traditional gates, thereby ensuring that all tolls were collected. Improvements in throughput were modest however. To meet the goal of faster toll collection, gates were removed, which necessitated the need for a new enforcement mechanism based on license plate recognition. As the penetration of ETC advanced, dedicated lanes were provided, in doing so separating and simplifying ETC and cash operations. Now it is frequently performed in a multi-lane ETC-only configuration.

AETC IS STILL THE STATE OF THE ART

To date there are few AETC operations worldwide and fewer still that were converted from an existing ETC operation that previously accepted cash collections in the lanes. Furthermore, many of the greenfield projects utilizing AETC systems were developed as public-private ventures, and were not subject to the same rules and expectations as those for purely public ventures. Most significantly, the performance of private concessions is a matter of profitability, whereas the public agency performance is dependent upon the public view 'efficient' and 'complete' toll collection from all who used the road (i.e. the ability to collect all of the gross revenue).

"TO IMPLEMENT AN AETC APPLICATION, THE FOCUS MUST BE ON THE 90% OF CUSTOMERS WHO INFREQUENTLY USE THE TOLL SYSTEM. THIS REQUIRES A THOROUGH STRATEGY FRAMEWORK FOR THE COST-EFFECTIVE USE OF ALPR ACCOUNTS"

Two major publicly operated toll agencies in the USA converted to AETC in July of 2009 and one converted a segment of its system in January 2009. Many more conversions of public facilities are planned, and even more are studying the potential of AETC. In Washington State, plans to install AETC on SR 520 – and ultimately on numerous facilities statewide – have resulted in the commissioning of a study of best practices to minimize toll operations costs. The study – commissioned by the Washington State Legislature's Joint Transportation Committee – recognized the importance of a new toll collection framework and business rules to address the unique aspects of AETC and the infrequent customer. The results of the study will help WSDOT achieve the most cost-efficient and scalable AETC system to meet the state's near- and long-term toll collection needs.

Many areas of the country are implementing high occupancy tolls (HOT lanes), which some consider as similar to an AETC application as all collections are carried out electronically. However, HOT lanes are quite different in that the adjoining

WHAT DID WE LEARN?

Increased ETC market penetration fueled the migration from mixed-lane, gate-down operations to separate dedicated ETC lanes. As gates were removed, safety issues became paramount with toll collectors walking across lanes and vehicles trying to anticipate the actions of the preceding vehicle. Such traffic operations challenges required changes in signing and roadway approach geometrics as well as an increased focus on overall plaza safety. We learned that signing and safety considerations changed considerably when toll plazas went from a stop and go low-speed environment to a high-speed environment.

In the development of ETC, many assumptions were made about customer behavior that proved to be wrong. Customers would often not properly install the transponders. or wave the device as they passed through the toll plaza. They also tended to be lackadaisical in maintaining account information, such as credit card, address, and license plate and vehicle data.

ETC business rules and the legal framework began to develop through experience as the industry started to recognize the importance these rules play in operational processing and associated costs. Postage became a common method of communicating with customers and customer service centers were seen as providing good customer service. Both have become major cost centers. As violations mounted and video technology was deployed, manual image review began to grow. Court administrators began to view the toll violation enforcement process as a way to create a new revenue source and penalties fees were used to defray court costs. All of these events conspired to create extraordinary back-office costs associated with ETC. Some agencies found that when these costs were combined with the ongoing high cost of cash collection, the result was an increase in the overall cost to collect tolls. It became clear that every effort should be made to increase the percentage of prepaid electronic transactions and to automate customer contact as much as possible. These new approaches were still manageable until AETC began to be introduced. Agencies quickly learned that such all-electronic systems created the need for a convenient method for the large numbers of cash-paying customers to pay tolls electronically.

Until toll operators began to implement AETC, there was not a thorough appreciation of the question of infrequent toll customers. As detailed

lanes provide a means for traveling in the corridor without having to be concerned with paying electronically. This is similar to the cash-collection option available on many mixed-lane toll facilities' roads.

AETC OPERATIONS COSTS

As AETC requires the toll operator to service many more customers than the typical ETC application, it is crucial to set proper strategies, minimize personal contact and use license plate imaging to provide for preregistered, prepaid accounts and day passes for the infrequent customer. Benchmark studies of ETC transaction costs have concluded that to maintain a low cost of transaction processing, business rules and pricing strategies must be thoroughly considered and marketing approaches developed to achieve a high number of transactions per account. When coupled with methods to minimize personal contact for the various types of accounts processing, costs can be contained.

Perhaps the most significant factor is an understanding of the strategies and business rules that must be applied. As the *tolltrans 2008* cover story highlighted, 60% of the trips are generated by 10% of the customers. To implement an AETC application, the focus must be on the 90% of customers who infrequently use the toll system. This requires a thorough strategy framework for the cost-effective use of ALPR accounts.

Such accounts must accommodate the vacationer, those one-time customers passing through the area, as well as occasional local customers. Rental car strategies are also important infrequent customer considerations. Preregistered and prepaid video accounts should allow for temporary accounts for the vacationer and more permanent accounts for the local occasional user. Day and week passes etc, also offer convenient choices for the infrequent customer. Pricing these toll payment options becomes essential to economically motivate customers to select the type of account that will serve them and the agency in the most convenient and cost-effective manner. Separate from the cost required to establish and manage an account, the technical process of acquiring an image, converting the image to a license plate number, and looking it up on a database and identifying the customer is inherently more complicated and error-prone than an RFID transaction and therefore more costly. However, the costs of carrying ETC accounts which have little activity can also be significant.

"IT IS CRUCIAL TO SET PROPER STRATEGIES, MINIMIZE PERSONAL CONTACT AND USE LICENSE PLATE IMAGING TO PROVIDE FOR PREREGISTERED, PREPAID ACCOUNTS AND DAY PASSES FOR THE INFREQUENT CUSTOMER"

in a previous article (*tolltrans 2008, Irregular Behavior,* page 6), there is clearly a difference between the number of customers (accounts) and the number of transactions (revenue). Subsequent studies confirm that a small portion of the customers (10-15%) generate the majority of the trips and revenue (60-75%). The converse is also true: 85-9O% of the customers will generate 25-40% of the revenue. There is little doubt that the manner in which infrequent customers are supported in an AETC environment will dictate the net revenue that is generated and the ultimate success of AETC conversions.

PRICING AETC ACCOUNTS

Economics and convenience drive customer choice. For the frequent customer, there is little doubt that the prepaid ETC transponder account with the provision for automatic replenishment is the most convenient and least costly. This is especially true when ETC transactions are discounted. However, for the infrequent customer, economics and convenience are defined quite differently.

The infrequent customer is less likely to be willing to purchase a transponder to handle one or two trips per month. They resist the upfront cost of the transponder and the initial account deposit, as well as the inconvenience of installing a transponder and dealing with battery issues and other tasks with which they are unfamiliar. Infrequent customers would be particularly adverse to a transponder account if a monthly fee was associated. If given an alternative to these inconveniences, they are willing to pay a higher toll. Also, as infrequent customers with transponder accounts require a higher degree of customer service (resulting in increased agency costs), providing an alternative prepaid account option requiring less interaction becomes a 'win-win' proposition.

When infrequent customers refuse to establish a transponder account, they are commonly treated as a violator, and subjected to administrative fees and penalties associated with billing systems. When transponder use and being treated as

a violator are the only options for infrequent customers, 90% of all the customers who use the toll road will be dissatisfied. Administrative fees and penalties should be reserved for those who take no action to establish prepaid accounts, and grace periods should be established for allowing customers to pay tolls without such fees.

Infrequent customers, vacationers or other temporary users of the toll road are also unique from local occasional users in that the more temporary the account, the less information needs to be collected. Some would argue that only the license plate number and valid payment information are necessary for a temporary ALPR account. As there is less information to be collected for a temporary ALPR account, contact methods can be devised that exclude personal contact. These include interactive voice recognition (IVR phone service), internet and SMS phone messaging, which could be used to keep the cost of account establishment to a minimum. Convenience for the infrequent customer and appropriate pricing will encourage many to establish prepaid video accounts in one form or another and thereby avoid violation-processing costs for both the agency and the customer. The more infrequent customers that are motivated to establish prepaid accounts, the less the number of potential violations that must be processed in a post-payment mode. This reduces license plate look-up, postage and other violation-processing costs, and also increases the likelihood of collection.

If pricing strategies for transponder accounts were set to entice frequent customers, one strategy might be to amortize the initial transponder cost over a period of time and to collect the capital cost through a monthly maintenance fee. The more frequently the customer uses the toll system, the less the additional cost per transaction – and once an established frequency of use occurs, the monthly administrative fee might be waived. This strategy also provides for recovery of the costs of maintaining transponder accounts.

Pricing should not be modified often and it is therefore important to analyze frequency of use and establish the proper business rules and pricing strategies before implementation. This information also serves in planning the marketing strategy for the various types of customers.

As ALPR accounts are crucial to the success of AETC conversions, improvements in video technology are all the more important.

STRATEGIES FOR ACCOUNT MANAGEMENT

VIDEO TECHNOLOGY STRATEGIES

Video technology effectiveness has improved in hardware, software and process. Anyone familiar with the advances in digital photography can attest to the extraordinary advances in image resolution and light adaptation. With greater pixel resolution, refined shutter and aperture control and the use of infrared lighting, the basic image to be converted has been vastly improved. Further, optical character recognition (OCR) software has advanced, providing a more accurate conversion of the image to a license plate number.

A further advancement in vehicle identification through video imagery is that of 'fingerprinting'. This technique collects the video characteristics of various points on the vehicle as well as the license plate, in essence digitizing data much like the technique used in human fingerprinting. Bumper stickers and other visual characteristics help to uniquely identify a vehicle. This digitized information can be saved to a file and used to match subsequent image data. In so doing, there is no need to process the license plate image through the OCR software each time that it reappears. This technique was demonstrated on a toll road in the USA in 2005, using a sample of 20,000 images. In this case, 83% of the images were matched through automation, 9.5% were matched to a reference image and 5.5% were matched with human intervention, leaving only 1.8% of the captured images unidentifiable. The example highlights the potential for automated vehicle identification using video imagery. Basic video technology has continued to improve since that time.

Crucial to the cost-effectiveness of

"DATA ON THE INFREQUENT CUSTOMER WOULD INDICATE THAT THERE WOULD BE MANY TIMES MORE ALPR ACCOUNTS THAN ETC TRANSPONDER ACCOUNTS"

Contact methods for establishing and maintaining prepaid accounts (ETC and ALPR) include person-to-person interaction in a customer service center, via telephone and also email, as well as person-to-person interaction at a third-party retail point-of-sale. Other methods include automated IVR phone systems and internet websites.

Studies indicate that a primary strategy in account establishment and maintenance is to minimize personal contact while still providing a high level of customer service. The type of account, the amount of data collected and the method of contact are prime determinants of operations costs in an AETC environment. Traditionally, the establishment of an ETC account required the collection of a considerable amount of data and the payment for and delivery of the transponder. Providing for the frequent customer was the primary consideration and the strategy of person-to-person interface ensured that all of the data was collected accurately. In an AETC environment this strategy must change in recognition of the fact that the vast majority of customers are infrequent users and less involved and knowledgeable about the toll road. They are less likely to spend much time or effort in setting up a prepaid account and few have an interest in placing a transponder device on their vehicle. AETC operations founded on the proper strategy will see many more ALPR accounts than ETC transponder accounts. In fact, data on the infrequent customer would indicate that there would be many times more ALPR accounts than ETC transponder accounts.

Account maintenance is also unique for AETC, so there could be several reasons for contact in this regard. Account data might need to be updated, for instance if an account has been closed or suspended, or as a result of some vehicle-related factor. You might also want to add or remove a vehicle, while there could be changes or additions to license plate details. Contact information – such as addresses, phone numbers, and email addresses – could change. Similarly, payment information could also alter, such as expiration dates

using video to identify vehicles in a tolling environment is the ability to process the transaction without the need for human intervention. In an ETC environment, images are collected on potential violations when an RFID communication is not completed properly. Some of these images are used to image-toll (Itoll) valid transponder accounts, with the remaining images passed on to violations processing. To ensure that no customer received a violation notice incorrectly, manual image review was a common practice. The statistical confidence limits on OCR software were increased to ensure accurate conversion to a license plate number and concurrently the percentage of images that did not pass the OCR conversion increased, resulting in more manual review. As long as cash collection was available there was an alternative for the infrequent customer and the number of potential violations was relatively small. That number increases significantly in an AETC environment.

In such an environment, images are used for matching existing ALPR and ETC accounts and the images are then retained for a grace period to allow for post-payment of tolls. Only then are the images considered potential violations possibly requiring manual review. The improvements in camera technology and fingerprinting coupled with enhancements such as dual OCR software processing decreases the likelihood of manual review. Furthermore, proper pricing and marketing of accounts for the infrequent user increase the probability of a match prior to violations processing.

on credit cards, cash account payments. There may also be questions or complaints, for instance about equipment-related issues including batteries, transponder failure, installation assistance, and also queries about violation restitution.

If it were possible to reduce the amount of data collected for an ALPR account – especially a temporary account or a day pass – there would be considerably less need to provide updates. Even for permanent ALPR accounts designed for local occasional users, the amount of account data should be kept to a minimum.

One of the primary reasons for contact with the customer service center is the issue of transponder acquisition, installation and maintenance. ALPR accounts should therefore require considerably less contact per account. Operations data should be maintained on the reasons for person-to-person contact and operations processes and/or pricing should be adjusted to maintain a balance between service and cost.

VIOLATIONS PROCESSING

Violations processing and enforcement typically require a considerable amount of personal contact. In an AETC system, violations processing could be overwhelmed by the large number of infrequent customers who no longer have the option of cash payment. Although violations might be minimized through various strategies such as marketing, pricing and convenience (grace periods, kiosks, etc), violations will nevertheless occur. Every effort should be made to resolve the potential violation before a uniform traffic citation is issued and the court system is engaged. Furthermore, a cost-benefit analysis can assist in determining the viability of continuing the collections process for customers who have few infractions. Recent data from one US agency that has been operating with AETC for a six-month period indicates that 68% of the violation notices sent were for individuals who had only one outstanding infraction. It can be inferred that infrequency of use leads to a large number of potential violators with very few infractions. In those instances where notices can be bundled into a single uniform traffic citation process, violation processing costs can be minimized. However, if there are large numbers of customers with few infractions, policy must be set based on the viability of pursuing collection. This is especially the case for those customers who may be out of state.

CONTACT METHODS FOR AETC

Many ETC operations considered it good customer service to provide multiple storefronts for customers to purchase transponders and service their accounts. Provisions were also made for internet access and IVR. This practice is still available for the frequent user – those people most likely to have a transponder account. However, for ALPR accounts the amount of data should be minimal and contact can be more adequately handled by electronic means rather than person-to-person communications. For ALPR accounts, it is crucial that IVR systems and internet websites be designed to provide quick and easy account set-up and minimal maintenance. Financial incentives can also be offered to ALPR account holders for those willing to use electronic communications to set up and maintain an account. If customers are willing to provide an email address or SMS message phone number, toll operators may even offer reduced toll rates.

THE FUTURE OF AETC

Early in the implementation of ETC, an urban expressway surveyed customers and determined that 92% of the vehicles were two-axle and the majority were local commuters. When ETC was implemented, the percentage of revenue collected electronically quickly grew to 60% on a 24-hour basis. It was therefore perplexing that long lines would form in the cash lanes at peak-hour, while the ETC customers were maintaining 25mph through the dedicated ETC lanes. Why were these local customers not purchasing a transponder and enjoying the greater convenience and time savings of ETC? The answer lies in understanding the paradigm of the infrequent customer – in particular the many infrequent customers that make up a small portion of the total revenue stream. The fact that cash collections were available was masking the identity of these customers.

For AETC to be successful, provisions must be made for the infrequent customer. It must be convenient and financially motivating. If a customer uses a toll road very infrequently, the amount of data necessary to establish the account should be minimal. Toll transaction pricing should encourage frequent customers to use transponders and infrequent customers to use ALPR accounts.

It's not safe to assume that the ETC business framework will be adequate for AETC and that one type of account – an ETC transponder account – is adequate for all users. Strategies must be devised for all customers to be provided a convenient means of prepaying tolls.

The conversion to AETC is a challenging undertaking but it is the future because it provides more net revenue and more convenience for all customers. AETC offers the promise of significantly lower collection costs and higher net revenue which can be reinvested in more transportation capacity.

AETC systems also offer policy options for transportation revenue and demand management. With AETC, Vehicle Miles Traveled (VMT) becomes a potential new revenue source for transportation infrastructure. HOT lanes and other congestion mitigation strategies become a possibility.

Finally, the closer that toll agencies come to electronically collecting 100% of their revenue, the greater the possibility for interoperability between toll road systems through ALPR accounts.

Unlike the evolved efficiencies of ETC, AETC strategies must be developed from inception and a full set of business rules established before implementation. With ETC, the industry was able to learn as the system progressed through the various stages of development – AETC is all or nothing. It must be done right at the beginning, otherwise there is significant risk of failure. Key to the success of AETC is an understanding of the needs of the infrequent customer. Failure to do so will force the industry to remain on the cash collections plateau in electronic toll innovation.

Dr Harold Worrall is the founder and president of Transportation Innovations, Inc – a consortium of toll and ITS professionals dedicated to stimulating innovation in the transportation community

Daniel Faust is the national toll practice vice president at AECOM

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