

KNOCK-ON EFFECT

DISRUPTIVE INFLUENCES IN ELECTRONIC TOLL COLLECTION

The direction ETC takes in the future may be directly influenced by emerging technologies such as 6C and continuing advances in license plate imaging. Could the two merge to present EVR as a contender for toll payment – and much more besides?

➔ Advances in electronic toll technology have been significant in recent years as it has come to be better understood and has been focused to the application. Also, as various technologies have been applied, ETC's weaknesses have come to be understood, resulting in modifications and improvements to the basic technology.

But some of these technologies and applications of technology could be 'disruptive' to the industry and the businesses that serve it. This term was coined in business schools to describe new technology that unexpectedly displaces established technology. It can be introduced

into an application area intentionally to provide functionality in a subsystem and as a result of its robust nature, expands to encompass and replace the technology of the overall application. It can also be adapted from deployments elsewhere. Potentially, two disruptive technologies in ETC are ISO-6C RFID and video tolling – and when considered together, the likelihood of huge changes in the ETC industry materialize.

ISO-6C

The history of the International Standards Organization ISO-6C is one that began development in 2004 with a group of

industry and academic experts. It was driven by an initiative to develop a protocol promoting global interoperability and leveraging advances in integrated circuit technology. The primary application area was freight logistics and supply chains but has since been adopted across many industries, including ETC, with multiple sources for system components. The design goals of 6C included a global open standard, multiple component suppliers and upgrade development paths that create competition and innovation and a royalty-free environment. These goals have created big economic advantages for the ETC end-user.

An openly competitive transponder and reader environment has led to recent procurements where transponders were bid below US\$3 and miniaturized readers requiring less power for the lane controller and cooling are being deployed at less than 50% of the purchase price of previous readers. The elimination of batteries greatly reduces the potential for operational failure and transponder changeout, while simplifying the life-cycle of procurement, distribution, maintenance and disposal. Toll operators understand that intermittent operation of transponders – occurring because batteries are nearing the end of



Video tolling, such as used by NTTA in Texas, will become increasingly important in the future due to low initial investments and excellent interoperability aspects

their life-cycle – can be a significant factor in customer service. And because the transponders are so small, they can be deployed in a wide variety of formats – including non-removable windshield applications, headlamp installation, license plate installation and hard-cased models – allowing portability between vehicles.

Higher read rates have increased data reliability as a result of the greater number of communications that occur as the vehicle passes through the ‘read’ zone, which also allows for a more robust security. Read rates in excess of 1,150 transponders per second have occurred with ISO-6C compared to 100 transponders per second for legacy systems. This ‘dense reader’ capability resulted from a strict requirement in the supply chain application development.

“READ RATES IN EXCESS OF 1,150 TRANSPONDERS PER SECOND HAVE OCCURRED WITH ISO-6C COMPARED TO 100 PER SECOND FOR LEGACY SYSTEMS”

At the heart of the security improvements is message authentication. Communication of stored information only occurs after proper authentications are verified, which allows information stored in a transponder to be protected from transmitting to (or being rewritten by) unauthorized readers. Furthermore, only transaction data is held on the tag and therefore no concern about obtaining personal information from the tag. Software improvements also allow for unique key management.

The manufacturing process is economical and supports large-scale production with reduced shipping, packaging and storing requirements. Authentication markings are applied to the transponder at the time of manufacture, which represents proof of the transponder origin. Globally unique identification numbers assigned at the

time of manufacture identify that particular transponder, so when coupled with tamper-evident packaging, transponder physical security is ensured.

INTEROPERABILITY

There has been a growing momentum for interoperability in the ETC market and advances are being made in interfacing the back-office operations of toll facilities. 6C technology adds to this momentum. Independent certification should be completed by the spring of 2012 and agencies will then begin specifying certified manufacturers in their Requests For Proposal (RFPs), while multiprotocol readers have already been developed and deployed that will enable transition and coexistence with existing systems. These

events will form the technological foundation for ETC interoperability and promote a non-proprietary marketplace.

6C technology has been established as the standard in numerous countries such as Turkey, Brazil, Mexico, Thailand and India. Electronic vehicle registration (EVR) has begun in each of the countries just listed with the exception of India, as well as being specified as a standard in several states in the USA. 6C technology is clearly assisting in the move toward ETC interoperability.

VIDEO TOLLING

Video tolling, sometimes referred to as video billing, is a technique for toll collection using video or still images of a vehicle’s license plate to identify the vehicle for payment. The license plate number is extracted from the image using Optical

Character Recognition (OCR), sometimes requiring manual data entry verification. It has become a focus strategy and requirement as toll agencies have begun to transition to all-electronic toll collection (AETC) systems. AETC applications require all users of a toll facility to have an RFID transponder, or their license plate will be read and a toll charged – usually with an additional admin fee. There is no opportunity to pay with cash in the lane.

Video bills are sent to toll users who have previously registered to pay tolls or to unregistered accounts – individuals who have not previously established a toll account. Registered customers are much like the typical ETC customer in that they have an established prepaid account. Unregistered customers’ vehicle registration information is procured from the state Department of Motor Vehicles (DMV) database using the license plate number obtained from video tolling.

Technological advances in cameras, license plate materials and OCR have occurred with regularity and have created a potentially disruptive technology in the ETC market. Traditionally, it has been difficult to depend upon video tolling for anything but a complement to RFID. The task is not just to ensure that all vehicles that create a video tolling transaction are billed properly – it is also important to ensure that a video bill was not sent incorrectly because one digit in the license plate was converted in error. To ensure the billing or violation is not sent to the wrong individual because of an incorrect license plate conversion, high statistical standards of three sigma are applied in the OCR process and this reduces the percentage of license plate images that are processed automatically without the need for human intervention. Because of this, automatic conversion of license plate images to digital numbers is considered to be excellent at 60%. But this means that 40% of the images must be reviewed, which significantly increases the operational cost

EMBRACING THE NEW BREED

Of the many benefits to be gained from employing 6C, the price point is particularly attractive to toll authorities – and a handful wasted no time in taking the plunge and deploying this new breed of RFID. Washington State's Good To Go! ETC brand, for instance, is now being offered in four 6C formats on SR 167 and also the SR 520 bridge: a Velcro-attached transponder in a bag (US\$8); a hard-cased transponder also attached with Velcro and a pull-down switch for HOT lanes (US\$12);

an external hard-body transponder that mounts to vehicles' license plates (US\$12); and finally, a permanently fixed sticker tag for motorcycles that is affixed to the headlamp (US\$8). Based on open standards, the readers and tags incorporate multiple protocols to allow for interoperability with WSDOT's legacy tolling systems.

Utah DOT, meanwhile, cited non-transferability as an important feature when it adopted 6C to identify environmentally friendly vehicles (hybrids, CNG, and electric vehicles). In tests, the fitted 6C tag was rendered useless after removal – the only one of the three 6C tags tested to have not functioned after being removed. This particular tag also features a holographic antenna and other elements that have, according to its manufacturer, never been used in a tolling application before.

Most recently, Colorado's E-470 Public Highway Authority announced its own transition from the T21 protocol to ISO 18000-6C for Denver's EXpressToll. With approximately 800,000 tags in use, issued to 380,000 accounts, the introduction of 6C will be done in phases. The move to the new transponder technology made because it easier for customers to install, provides enhanced signal reading capability, and is less costly for EXpressToll to acquire and mail out to its customers.



of video tolling. These types of errors are common due to the many fonts and license plate designs, especially in the USA.

Approximately one-third of states issue embossed plates only, one third issue flat-screen plates only and one third issue a combination of the two. A little over half of the states require front and rear plates, slightly less than half require only a rear plate and two states require only a rear plate for some passenger vehicles. In addition, a variety of temporary tags and decals are used to identify newly purchased vehicles until a complete registration can be accomplished and a permanent license plate issued. Furthermore, some vehicles are not properly registered, with estimates ranging as high as 15% in the USA – other countries estimate even higher percentages of improperly registered vehicles.

Finally, to ensure bills go to the proper individuals, the correct addresses must appear in registration databases. Frequently, though, addresses are not kept up to date and 20% of database inquiries return the incorrect details. After the first billing

Electronic tolling with 6C starts in December on the SR 520 bridge to help pay for the construction of a new faster, safer bridge

is returned to the tolling agency, many use commercial services in order to identify the correct one.

Technological advances in video tolling may change much of this. Invisible inks have been developed to print barcode symbols that can be seen only with infrared cameras. Tests of this type of technology have shown read accuracy in the high 90% range. This also makes it more feasible for law enforcement to easily identify registration information in the field, reducing the probability of improper registration. When this technology is coupled with a more timely process for ensuring the correct address in vehicle registration databases, video tolling will become a very powerful and perhaps disruptive technology.

SUMMARY

Technological advances such as video tolling and 6C RFID are powerful direct influences

on the future of electronic tolling. However, indirect impacts may occur as a result of these technologies being deployed in related application areas. If advances in RFID and open architecture continue to drive the cost of transponders and readers lower, applications such as EVR may begin to materialize, as already seen in Mexico, Turkey, Brazil and Thailand. After one cycle of registration, transponder ubiquity occurs and all vehicles have transponders that can be read in the ETC environment.

This greatly reduces costs in transponder inventory control and distribution, identifying vehicle owners who have not set up tolling accounts and reduces some of the inherent costs incurred because of vehicle registration processes. All of this could occur with the implementation of EVR – a related but separate application area. Certainly there will be concerns for privacy but considering current capabilities to track vehicles, personal financial transactions, cell phones and internet transactions, EVR detracts only slightly in the level of privacy available at present.

Technological advances will continue to occur and application areas beyond electronic tolling will continue to utilize these advances. The combination of these events will likely lead to a new and unique electronic tolling industry in the future. ■

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. Telephone +1 407 512 4189, or email Trans.innov@gmail.com for more information. Alternatively, log on to his website at www.Trans-innov.com