

Cooking with Chile

by Andrew Pickford

DSRC comes of age

As *TTi* and *Tolltrans* has reported countless times over the past few years, the history of Electronic Fee Collection has shifted from battles between proprietary technologies, to battles to create standards and finally battles between standards as international player seek global rewards. However, this is the next chapter in the story of how Dedicated Short Range Communication (DSRC) technology has reached the next stage in its evolution as demonstrated in a cluster of infrastructure projects in one of South America's economic success stories – Chile.

Firstly, a review of how standardised, multiple-sourced DSRC arrived in Chile from its humble origins in Brussels over 10 years ago. The Comité Européen de Normalisation (CEN) committee TC278 and its working groups had, since 1991, been developing a set of specifications that defined the operation of a business-critical process for highway operators; securely and reliably identifying and debiting the correct account for each tagged vehicle passage at highway speeds. This is known as Electronic Toll Collection (ETC) or more generally as Electronic Fee Collection (EFC). Distracted by the twists and turns of DSRC standardisation over this period it was too easy to forget that, behind the scenes, other companies had been working hard to improve the other necessary building blocks of EFC including License Plate Recognition (LPR) systems, vehicle classification equipment, data encryption

The electronic fee collection industry has reached an important milestone in Chile. The availability of Dedicated Short Range Communication technology from multiple, competing suppliers committed to interoperable systems is now a reality. This is the story of DSRC growing up and how interoperability has now reached a higher level



engines, wide area networks (WAN), optical storage methods – all chasing exponential growth in the market for EFC products.

Overall, a consommé of technologies and capital investments are needed just

to read an onboard unit ('tag') or license plate in stop-and-go traffic or at normal highway speeds – backed up enforcement and vehicle classification technologies. Hundreds of thousands of hours of development were needed to enable

drivers to pay a fee reliably – without stopping on the highway.

Essential ingredients

In some recent projects, the reasons why EFC has not been deployed have not been technological but political as highlighted by congestion management projects put on ice in the Netherlands, Hong Kong and Sweden. Nevertheless, the benefits of EFC are already well-known by around 20 million motorists worldwide from the UK to Japan, Denmark, the US, Malaysia and Australia – some of an estimated 40 countries that have already made the investment in EFC painlessly, although usually linked to new infrastructure developments rather than introducing charging for existing highways, bridges or tunnels.

Paying a toll at normal highway speeds on an open highway (rather than constrained by the lanes in a toll plaza) has proven to be technically more challenging. The quantity of projects is still low but growing, notably Highway 407 (Canada), Melbourne City Link (Australia), Cross-Israel Highway (Israel) and recently Santiago de Chile – home to one of the most ambitious urban tolling programmes worldwide but also a milestone in the development of EFC.

“GSS and A1 put the road user – not the EFC equipment suppliers – as the primary beneficiary of standardisation”

Major multivendor EFC projects: 2002

- Santiago de Chile: Costanera Norte, Norte Sur, Ruta 68 all using GSS- and A1-compliant DSRC systems specified by three highway concessionaires with two more to follow in 2002/2003.
- Spain: ACESA exchanging legacy 2.45GHz system with EFC equipment according to the CESARE (GSS-compatible) spec, includes an initial 50,000 OBUs and 307 RSS.
- UK: Dartford River Crossing exchanging proprietary read-only tags/RSS with 150,000 OBUs from Combitech Traffic Systems and 24 RSS from CSSI RSS. GSS and A1 used as specification.
- France: Telepeage Inter Societe (TIS) approaching 100,000 OBUs and 2,000 RSS.
- Australia: Sydney Harbour Tunnel, Eastern Distributor, Gateway Bridge – all in Australia and deployed by various system integrators.

Overall GSS-specified EFC systems are in use in Belgium, Denmark, France, Greece, Ireland, Sweden, Switzerland, Spain, Turkey and the UK. Outside Europe GSS systems can be found in Australia, Malaysia and Chile.

Figure 1: Multivendor EFC (source based on ‘Dedicated Short Range Competition – Part 2’, TTI

Recipe shortcuts

In principle, to purchase a complete EFC system a highway operator or system integrator needs to understand the characteristics of the vehicle-to-roadside communication link and to understand the merits of each alternative system. Financing and policy-making are usually the other essential ingredients in a successful EFC scheme that is aimed to meet the financial needs of the investment providers, to better manage congestion or to perform as one of many tools available to the highway control

engineer or local government. However, as the size and complexity of toll collection systems increase then, potentially, so does the number of competing messages between DSRC vendors and system integrators.

Fortunately, parallel DSRC standards development in the US, Europe and Japan has already created a technical shorthand to assist procurement in each of these regions. Simply by referencing a well supported, public domain, DSRC standard the highway operator has some reassurance that DSRC vendors have not focused on proprietary vehicle to roadside communication links when competing proposals are reviewed. However, as TTI has already highlighted, DSRC standards have proven to be necessary but not sufficient for interoperability, hence industry initiatives such as GSS or A1 to

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ensure technical interoperability between DSRC systems from different manufacturers (Figure 1).

To use an example, this means that your tag issued by toll operator A can be processed by toll operator B and vice versa. The whole content of the message may not be completely understood but, simply, the DSRC systems can be said to be ‘talking the same language’ and sufficient to complete the charging transaction. Initiatives such as GSS and A1 intend to remove the ambiguity in standards and create a minimum interoperability profile (GSS) and toolkit of commands (A1) that all operators can implement and use to process customer tags issued by other operators. In short GSS and A1 puts the road user – not the EFC equipment suppliers – as the primary beneficiary of standardisation, removes

the confusion created in the heat of the standardisation battle between DSRC suppliers, promotes ongoing competition and helps drive up the mass-market adoption of EFC.

In Europe, draft specifications (prENVs) were balloted and approved in 1998 by a majority vote amongst the members of CEN, which included the national standards bodies of all EU member states, EFTA and the Czech Republic. From European origins was created the EFC success story of 2002; the majority of new EFC systems recently sold outside Europe and the US are compliant with the CEN DSRC specifications developed by the committee CEN/TC278. Many of these also required compliance to GSS and A1, including the multiple highway concessions in Santiago de Chile – home to one of South America’s largest

infrastructure programmes – and one of its most controversial.

Down under in Chile

Santiago’s emergence as a first world city has been catalysed by significant public works development over the last 30 years. However, constrained by its transportation infrastructure, in 1994 the Chilean government authorised a US\$3 billion spending plan to upgrade and expand its transportation infrastructure based on open competitions for construction and operating concessions for new or upgraded highways.

The five primary highway concessions, including the feeder Ruta 68, are shown in Table 1 below – all serving downtown Santiago de Chile and its suburbs. Costanera Norte was the first concession to be granted by the Ministry of Public Works (MOP) after overcoming significant legislative, environmental and political hurdles. After cancellation in 1999, following low levels of bidder interest, the project was relaunched in a more attractive package. This included a more environmentally acceptable

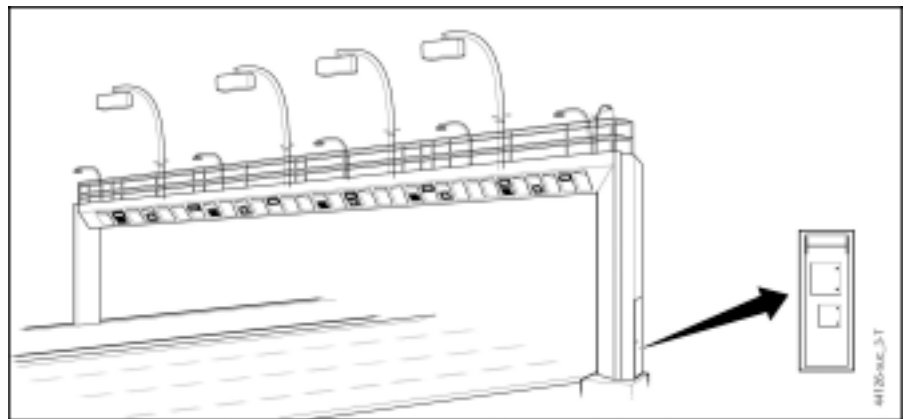


Table 1: Projects, concessionaires and contractors in Santiago

Concession/ project (highway length km)	Concessionaire	Main subcontractors	ETC supplier	Central system supplier	Start of operation	Number of charging gantries
Costanera Norte (38)	Costanera Norte	Impreglio	Combitech	Ascom	Dec 2003	15
Norte-Sur (60)	Autopista Central	Dragados/ Skanska	Combitech	SICE	22 Dec 2003	29
Americo Vespuccio Sur (24)	Autopistas Metropolitanas	Sacyr/Necso	Contract not yet awarded	Contract not yet awarded	Dec 2004 (to be agreed)	14 (tbc)
Americo Vespuccio Nor Poniente (29)	Vespuccio Norte Express	Dragados/ Hochtief	Contract not yet awarded	Contract not yet awarded	2005 (to be agreed)	15 (tbc)
Ruta 68 (100)	Rutas del Pacifico	ACS/Sacyr	Indra/ Combitech	Indra	Oct 2002	18 lanes (plaza based)

routing along part of the Mapocho River, improved government guarantees and risk-sharing options to reassure potential investors that the scheme would be profitable despite other, nearby local highway developments.

The Costanera Norte project requires significant integration with existing infrastructure and, in total, is expected to cost US\$430 million. Motorists will be charged based on a declared vehicle classification, number of highway segments travelled and a time-of-day adjustment based on historically measured congestion for each segment. The EFC technology will be open-highway multilane DSRC with overhead vehicle classification and video enforcement using LPR. Drivers also have the option to be charged (for a small premium) without a tag by registering the vehicle license plate for a 'Targeta' payment. This uses LPR to link the vehicle's license plate with registered 'Targeta' users. Otherwise LPR is used conventionally to identify the license plates of suspected violators for off-line comparison with the vehicle registration database. This database is unfortunately still rather fragmented and incomplete so this will be the true test of EFC system credibility. The planned operational start date for the first segments of Costanera Norte is December 2003.

Notably, this tolled highway programme has short-circuited the public argument on applicable standards and interoperability for the DSRC air interface. From the start MOP's objective was to ensure that a highway user would only need one tag. MOP therefore required all deployed EFC systems to comply with the CEN DSRC prENVs, GSS and A1 specifications. At time of writing, at least five companies had tendered compliant EFC technology to concessionaires.

With this level of commitment from competing EFC system suppliers to technical interoperability, the concessionaires can focus on how to realise the 'one tag' requirement through the back-office without inconveniencing road users. At time of writing, the concessionaires were

New routes to charging for EFC

- The mass market example: buying a pre-paid mobile phone: The user chooses the outlet, the network operator, the mobile phone/tariff combination. The phone is owned by the user and the contractual relationship/application profiles are defined by the installed SIM card. No bills. Enforcement through denial of network service. Roaming taken for granted.
- 'Operator-centric' interoperability for EFC: The highway user contacts the highway, bridge or tunnel operator directly. The tag is distributed by (and owned by) the operator. Fees are collected by the operator or by an authorised agency. Enforcement immediate (i.e. barrier) or deferred penalty (owner traced through license plate identification). Roaming technically possible but depends on bilateral agreements between highway operators.
- 'Consumer-centric' interoperability for EFC: The user chooses the outlet, on-board unit, preferred travel Value Added Services Provider (VASP) and bundled services/tariff/billing mix. The onboard unit is owned by the user and contractual relationship/application profiles defined by an installed Security Application Module (SAM) owned by the VASP. Enforcement through immediate denial of services and deferred penalty (owner traced through license plate identification). Roaming between charged highway segments for all (or most) services taken for granted.

Figure 2: Interoperability perspectives (source: based on 'Dedicated Short Range Competition - Part 2', Tti)

still locked in debate on how to achieve this, possibly through a common clearing house rather than a series of bilateral agreements to accept and process EFC transactions from other roads. This approach can be described as 'consumer-centric' as described in Figure 2.

The German test laboratory TÜV was selected by MOP to verify technical compliance of the roadside-to-vehicle communication link components with the CEN, GSS and A1 specifications. This is believed to be the world's first use of an independent test laboratory to verify compliance against public specifications and interoperability definitions for an EFC project of this scale with multiple competing suppliers.

Concessionaires are now able to freely select the EFC suppliers that best meet the concessionaire's own business case needs including equipment reliability, transaction security, cash flow profile and operational cost requirements over the life of the concession.

Side salad

Overall, MOP's intention is to accelerate the adoption of EFC amongst commuters and commercial operations in the Santi-

ago de Chile area. So, to ensure that momentum is built early, MOP requires each concessionaire to provide the tags without any charge to users. For Costanera Norte and Norte Sur the expected tag penetration levels are 95% and 85% respectively based on traffic volumes forecasted by the concessionaires. For Costanera Norte these forecasts are partially underwritten by the Chilean government through a risk-sharing mechanism with the concessionaire Impregilo. Typically, for a new highway, a financier would expect the EFC infrastructure costs, including all charging systems, central systems and back office administration to be around 10 per cent of the total project value.

A rapid ramp-up and high penetration of EFC is therefore required to offset the large capital expenditure. It also means faster public 'learning', lower initial rates of violations and therefore a smaller administrative headache with reduced loading on the back office system. Precedence in North America suggests that start up violation rates can overload central system operations so MOP appears, at least at this stage, to be on the right track. The burden then shifts to the concessionaires to ensure efficient distribution and marketing of EFC tags in the region to ensure that the penetration targets are met with 'Targeta' available for casual or infrequent users.

The heat is on the concessionaires to secure the targeted profitability and

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internal rate of return on the original investment by or before the forecasted date. For the Chilean government and concessionaires multilane free flow EFC systems are simply regarded as a necessary tool to help meet these financial targets.

Dessert

Several DSRC systems suppliers competed for the first three concessions and continue to claim compliance with GSS and A1. Amongst them are Combitech Traffic Systems (current market share leader in Chile), CSSI, Thales and Denso. Claims of interoperability will still need to be independently verified by TÜV but interoperability effectively separates the need to procure tags and roadside equipment from the same company. Initial contracts include EFC tag supply but none of the concessionaires need to maintain supply contracts beyond the initial start-up volumes.

MOP's advertised concession programme now includes 21 highway concessions – significant potential for ITS, including EFC. Other opportunities in access control, parking and fleet management have also been identified as

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secondary uses for EFC tags in the Santiago area.

Overall the general acceptance of EFC as a reliable revenue collection tool means that the Chilean government was able to prescribe EFC as an integral part of the highway network as its plans were being conceived. No one ever compared the procurement of a highway with the purchase of DSRC technology but at least in this example both can now be provided through open competition from multiple sources.

Santiago de Chile's intense public works programmes will continue well beyond 2006. Hopefully, every future project will also be seen as attractive enough for sustained international competition although with a commitment to

interoperability, this is one road already quite familiar to EFC suppliers. ■

CEN can be found at www.cenorm.be/ and the CEN TC278 document list at www.nni.nl/cen278/. The GSS and A1 documents can be located at www.etc-interop.com by October 2002.

Further general information on the concession programme in Chile is located at www.concesioneschile.cl and MOP at www.moptt.gov.cl.

The home pages for the two largest concessions can be found at www.costaneranorte.cl and www.autopistacentral.cl.

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