Mass appeal

The future for DSRC, part 2

by Andrew Pickford, Transport Technology Consultants, UK

In the second of the series, the author looks at the near-term future of dedicated short range communication technology as it emerges as a viable mass-market technology for road charging applications with multiple, competing suppliers deploying interoperable systems. The trend continues…

There are many examples where standardisation has helped unlock the competitive potential of an industry. I can buy a tyre knowing that it will fit the wheels on my car. I can buy a GSM phone from Hong Kong and know that it will function in Norway. I can buy an A4 scanner in Japan and know that it will work with my computer back home in the UK. All of this has been made possible through early cooperation between industry suppliers leading to widespread distribution of highly differentiated, yet competitively priced products. So, all that I need to know as a consumer is (other than the size of my wheels) which standard applies. Simple.

So what has this got to do with DSRC? Well, the Comité Européen de Normalisation (CEN) committee TC278 and its working groups have, since 1991, been developing a set of specifications that define the operation of a short-range (typically less than 15m) radio interface between a tag fitted to the inside of a vehicle windscreen and short-range roadside equipment. This vehicle-to-roadside communication link at 5.8GHz is used for the transfer and updating of data read from the tag to identify a user account and the means to pay - a business critical process on highways that use electronic fee collection (EFC). The draft specifications (prENVs) were balloted and approved in 1998 by a majority vote amongst the members of CEN, which includes the national standards bodies of all EU member states, EFTA and the Czech Republic.

The confidence that this process would be concluded as a final set of specifications (prENs) led many manufacturers to develop pre-standard DSRC solutions and deploy them in Europe, Asia and South America through competitive tenders for EFC systems. The success of this is a prime example of a European standardisation process helping European suppliers compete outside of Europe. Since December 2001 for example, South Africa and Chile have been added to the list of countries that have either adopted or prescribed the use of CEN standards-compliant EFC technology for major highway build or upgrade programmes.

Box 1: Major multi-vendor EFC projects in 2002

- Spain: ACESA exchanging legacy 2.45GHz system with EFC equipment according to the CESARE (GSS compatible) specification, 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.

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.

Seeds of growth

By 2002, from European origins, the majority of new EFC systems sold outside Europe and the USA were compliant with the CEN DSRC specifications developed by the committee CEN/TC278. Historically though, highway operators had a limited choice. The tags, or on board units (OBUs), and roadside systems (RSSs) had to be purchased from the same system integrator or DSRC supplier. This same vendor would, for the life of the EFC system (typically 8-10 years), provide upgrades or OBUs as the sole source – against limited (or usually no) competition from other DSRC technology vendors.

The publication of the global system specification (GSS) supported by Thales, Kapsch, Combitech Traffic Systems (a Kapsch subsidiary), CSSI and Transcore turned this historical dependency on its head by creating GSS 2.0, an interoperability definition compliant with the ENV specifications. So, let's consider this further.

Adoption agency

The route to decouple the RSS supply from the OBU supply requires, as a minimum standardisation of the air interface, widespread adoption by DSRC technology vendors and recognition of the benefits of second sourcing of OBU and RSS based on a public interoperability definition such as GSS and A1 (a related 'toolbox' of EFC functions and security features). These documents sit precisely at the interface between OBU suppliers and RSS suppliers so they have been of strategic importance to technology vendors.

GSS enabled highway operators to separate the procurement of OBUs from the RSSs for the first time. The GSS initiative was the result of over five years of work by several vendors that resulted in several highway operators in Europe procuring OBUs from one supplier and RSSs from another (Box 1) as part of a new build or to replace vintage early 1990s EFC systems.

Many European DSRC technology vendors have already participated in multi-vendor procurements in Europe, Asia and South America and this has helped propel the CEN specifications as an integral part of successful procurements, and where specified, supported by GSS and A1.

New views, new relationships

The general acceptance of EFC as a reliable, readily available revenue collection tool means that highway planners can now prescribe EFC before the highway is built. Historically of course, the suppliers of RSS also provided the OBU. However, the simple principles of economies of scale suggested that the low volume/high value RSS may, in the future, be provided on a different basis to the high volume/low value OBU – by different suppliers at different times or even through separate channels (Box 3). RSS to OBU ratios of 1:1,000 in the early 1990s are now nearer to 1:100,000 in open highway projects in Australia, Singapore and Canada. Similarly, the volumes of tags distributed are increasing at

traffic technology international

Box 2: Global EFC trends

- Quantity of OBUs deployed (or contracted to supply) approaching 20 million worldwide;
- Continued growth in number of toll lanes at 15-20 per cent per annum;
- EFC now routinely considered as a viable revenue collection tool for plazas and open highways (e.g: Australia, Israel, Singapore and Canada);
- New market segments – replacement single lane and open highway in addition to original retrofit plaza segment;
- Replacement of proprietary DSRC solutions at end of life with ENV compliant solutions in Europe;
- Adoption of CEN DSRC specifications outside of Europe for public procurements (e.g: South Africa and Chile) and by DSRC technology vendors (e.g: USA and Japan);
- Recent adoption of DSRC standards at 5.9GHz for USA;
- Emergence of nationwide coordinated procurements (e.g: TIS in France) and interoperability requirements (e.g: the UK government agency DTLR).
- Emergence of EU-wide specifications e.g: CESARE specification initiated by ASECAP (European association of toll roads) based on industry interoperability specifications such as GSS and A1;
- Increase in multi-vendor (RSS and OBU) procurements e.g: Dartford river crossing (UK) and ACESA (Spain);
- Spectrum allocation differences in Europe, US and Japan continue – meaning OBU and RSS products differ at the level of physical layer in each market.

Box 3: New EFC charging routes

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 on-board unit is owned by the user and contractual relationship/application profiles defined by an installed SAM (Security Application Module) 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.

a faster rate than the number of EFC lanes deployed, in single or multi-lane configurations.

EFC is becoming a strategic revenue collection tool for organisations that invest in and operate highways, bridges or tunnels, and the largest EFC projects are getting larger as recent contract awards in France (for RSS) and Santiago de Chile (turnkey systems) demonstrate.

This suggests that partnerships and working relationships within the EFC industry will need to be continually re-invented and dependency on proprietary DSRC interfaces forgotten as we move towards a mass-market future with over 15 million active users paying road charges electronically on a regular basis worldwide. Pan-European organisations such as CEPT and ETSI also have a continuing role to ensure that the radio spectrum needs of DSRC can co-exist with other commercial and governmental interests.

Interdependency

The interdependency between major infrastructure projects matches the increasing economic dependency between regions and not only in Europe. Major highway building projects in China, South America, eastern Europe, sub-Saharan Africa and South East Asia means that highway development programmes are often coordinated with other local infrastructure developments such as ports, airports and new town development. Santiago de Chile is currently home to the largest highway-building programme in South America. This project involves the building and upgrading of four traffic arteries – all of them to be tolled with EFC. In this project multi-vendor EFC procurement was regarded as essential although in total the equipment value (including OBUs) was projected to be less than 5 per cent of the overall project value. The final nomination of the highway building consortia included EFC suppliers that, in this case, resulted in the automatic selection of OBUs and RSSs compliant with CEN DSRC specifications from several manufacturers, all committed to GSS.

Having interoperability does not limit competition or innovation but lack of it could limit the adoption of EFC by restricting the consumers' and operators' right to choose an OBU and use it freely for toll payment.

However, true interoperability, as the first article in this series highlighted, also requires operators to create contractual alliances. The arrangement adopted by the operators of the Storebælt and Öresund Bridges on the E4 highway from Copenhagen in Denmark to Malmo in Sweden provides a good example. Although a highway user needs to apply to each operator, the EFC fees can be charged at both crossings with one OBU and to one credit card account. Extending this further by adopting another example from mobile telephony could mean that, in the future, a highway user may be able to open an account with a highway payment service provider that would be recognised at all road charging points whether on the open highway, toll plaza, city or public car park.

> "The publication of the global system specification turned this historical dependency on its head by creating GSS 2.0"

Don't leave home without it

There are other trends that have faced the European EFC industry that are on the path to ensure that an OBU, as a potential gateway to ITS services, may be as ubiquitous as the mobile phone (Box 2). The signs of growth are encouraging - standardised European DSRC technology is already being widely deployed outside Europe.

More recently, the CEN DSRC specifications have been adopted by several Japanese vendors as the basis of a national public-private interoperability initiative that took seven years to conclude. The Japanese consumer also benefits as highlighted during a recent visit of the Japanese Highways Industry Development Organisation (HIDO) to the UK. Although not yet widespread the standardised OBU are available from car dealerships and car accessory shops in major metropolitan areas in Japan. This is closer to the concept of consumer-centric interoperability (Box 3) already enjoyed by mobile phone users.

What's next?

The progression from ENV to the final EN status now needs a final concerted and focused effort within CEN from all parties that believe in a competitive, multi-vendor and interoperable future. This was the expectation of CEN and all of the members of CEN/TC278 and its subworking groups when it was established. It would be a poor alternative if the already successful deployment of CEN DSRC compliant systems, as examples of multi-vendor procurements in Europe, were in conflict with the EN itself. This would be contrary to the requirements of the European Council of Ministers that stated in 1999 the requirement to ensure, through standardisation "…the convergence of EFC systems in Europe…" with "…the desire to create pan-European interoperability of systems and to create a Europe-wide market for related equipment" (CEN BTC121/ 1999).

Anyway, aside from the necessary bureaucracy, on a global scale, the benefits of rapid standardisation to highway operators and consumers has also been recognised by the USA and Japan – also home to innovative DSRC technology vendors and system integrators – now focusing on the same international procurements as the Europeans vendors.

Over five years experience of deploying EFC systems compliant with currently available CEN specifications means that highway operators can now purchase an EFC system with confidence and that the standards on which the EFC technology were based have been thoroughly debugged and proven in international procurements. So, with the backing of multiple DSRC technology vendors, interoperability initiatives compliant with the recently announced GSS 3.0, the A1 specification and stable CEN EN specifications it will mean that in the future I may be able to buy my OBU at the same dealership that I buy my car tyres. However, I am not (yet) able to swap the colour of my OBU to match my red, white and gold car ... ■