Sweden plans to introduce an HGV kilometre tax in 2011 – this will be the first time that any country has attempted to implement the business model that lies at the heart of EETS Directive.

ARENA heads for the big stage

The ARENA name may not yet be tripping off the tongue around Europe but it is certainly set to make waves over the next year. ARENA is a major project which started in Sweden in April 2006 to scope the possibilities for the introduction of a kilometre tax for heavy goods vehicles. ARENA reported in April this year and a succession project, ARENA 2.0, is now underway.

ARENA is special because this is the first time a country has planned the introduction of a kilometre tax which will comply fully with the requirements of the European Electronic Toll Service (EETS) Directive. Sweden has looked at the challenge of interoperability and understood that this does not just apply to existing technical solutions and a limited number of equipment suppliers but must offer a fully open market to all comers and to new technologies as they emerge. It is a big challenge and if all goes to plan, the first demonstration of this approach will be showcased at the Stockholm World Congress in 2009 putting EETS fully to the test for the first time.

The background

The existing tax system for heavy goods vehicles in Sweden is based on fuel tax and vehicle tax. In addition to these taxes there is also a road toll, or Eurovignette, for using the road network. The Eurovignette toll is a collaboration between Sweden, Denmark, Belgium, Luxembourg and the Netherlands.

The first step towards a kilometre tax in Sweden was a road tax investigation which took place between 2002 and 2004. This investigation included a review of all road and vehicle tax systems and proposed the introduction of a kilometre tax. This was to take the form of a levy of tax on all goods vehicles, both foreign and Swedish, with a gross weight over 3.5 tonnes that use the public road network. The Swedish parliament adopted the report in 2006 with reservation. This reservation related to the economic impacts that the tax might have and as a result the government commissioned SIKA (Swedish Institute for Transport and Communications Analysis) and ITPS (Swedish Institute for Growth Policy Studies) to analyse the impact of an introduction on both regions and industry. These studies were concluded in 2007. One additional report has to be added to this list and that is the findings of the Parliamental Climate Committee which reported in March 2008 and proposed the introduction of the kilometre tax for HGVs from 2011 provided that the technology was sufficiently developed and affordable.

The European context

When the ARENA project got under way, kilometre tax or distance-based road user charging systems were already in place in Switzerland, Austria and Germany and in January 2007 the Czech Republic also introduced kilometre taxation. There was much to be learned from the experiences of these countries. At the same time there was the European dimension to take into account, in particular the revision of the Eurovignette Directive, which built a framework for the implementation of road use charging, and the EFC Directive which defines the European Electronic Toll Service (EETS) which aims to ensure that the vehi-

ARENA – more intelligence, less hardware

cle driver can pay for road usage using the same on board equipment, the same contract and with a single invoice, regardless of where he travels within Europe.

The ARENA concept

The first step identified by ARENA was the development of a conceptual systems design. The authors say that they decided to use the term conceptual in order to underline that the solution should be generic rather than specific, in the sense that it should be possible to implement the result in several ways. What this means is that they were trying to define the system independently from its final technical design, the motivation being that the time horizon for the realisation of any system was 3-6 years away and during that period considerable changes were likely to take place in terms of the technology available.

The key requirements of the concept designed were defined as a system that:

- would make it possible to levy a tax throughout the entire network;
- would allow differentiation as regards road characteristics;
- would allow differentiation of static and dynamic vehicle properties;
- and would be interoperable with the coming EETS service.

Figure 1 shows the system architecture. The key point here is that the two main functions, 'Collect Kilometre Tax' and 'Perform Payment' are completely separate. Because the payment structure will be defined through EETS, ARENA focussed on the Collect Kilometre Tax function which involves measuring, calculating and supplying all information needed to calculate and pay the correct tax. The function also ensures that the tax is correctly paid.

The payment concept is based on:

- vehicles subject to kilometre tax having specific vehicle equipment for this purpose, the OBE (on board equipment);
- the OBE continually registering the vehicle's position and time in a protected memory card;
- use of the OBE being mandatory, but the system able to offer an emergency solution if, for example, the OBE stopped working;

The three most important stakeholders is this system are the user, who pays for the road usage, the Toll Charger who levies the tax (for instance the Swedish Tax Authority) and the Toll Service Provider who serves as the middleman between these two stakeholder and also supplies systems functions and equipment.

The payment process requires that a vehicle position, with time stamp, is continuously registered and sent to a toll service provider – mobile communications could be used for this function. The toll service provider generates a receipt of the information and confirms delivery to the OBE. The toll service provider then translates the data received into a road description using map matching which is combined with static and dynamic vehicle data to produce a route declaration. This is sent to the toll charger who calculates the tax and sends the tax claim to the toll service provider. The toll service provider verifies the claim, pays the tax and then invoices the user.

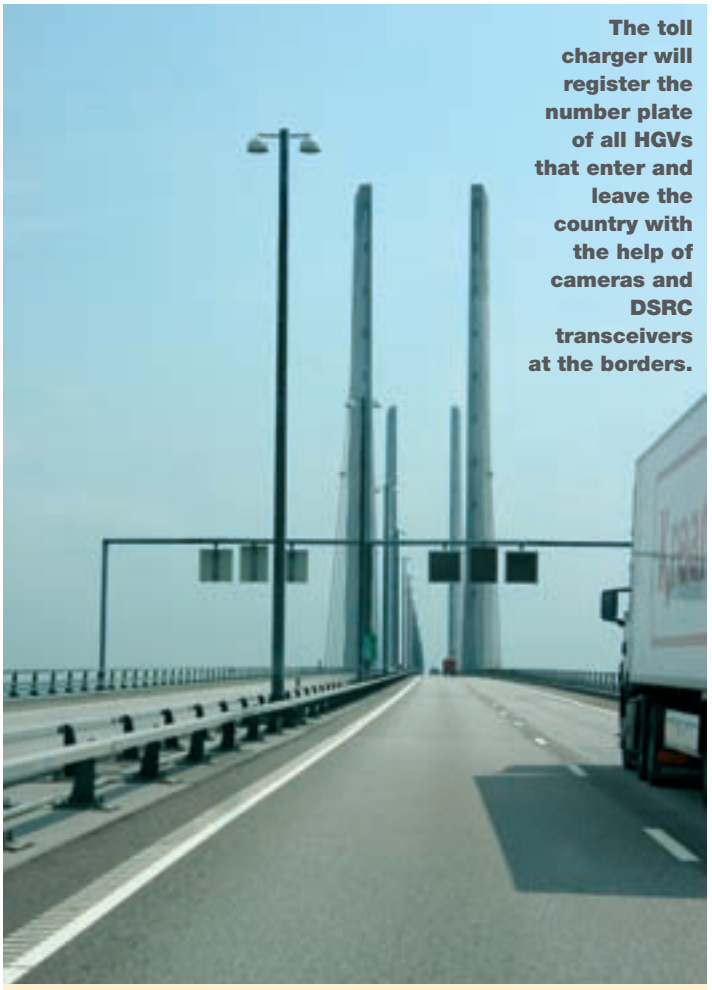
Compliance is seen as the key to successful implementation. A system based on physical installations throughout the entire taxed road network – as is the case in Germany, Austria and the Czech Republic – has been ruled out for Sweden as too expensive, the road network being far too large. Instead ARENA has suggested that compliance be focussed on control mechanisms related to business processes – in short more intelligence and less hardware – along with a supervisory authority mandated to make roadside checks and with the powers to stop vehicles.

The contractual relationship between the user and the toll service provider will also be vital for compliance. For instance, the mandatory OBE, which applies to both Swedish HGVs and foreign vehicles, means that the toll charger will know at any point in time which vehicles are liable to pay tax.

The toll charger will register the number plate of all HGVs that enter and leave the country with the help of cameras and DSRC transceivers at the borders, as Finnish Customs do today. That means the toll charger will know which vehicles are expected to submit a route declaration. When the vehicle leaves the country it will be required to make a final route declaration – if this is not done within a certain period the vehicle will be blacklisted and if it enters the country again, the authorities will be notified that a 'tax dodger' is on the roads.

Any toll service provider who wants to operate in Sweden must provide detailed information about its system and services before the company is approved based on the guidelines established for the EU. The toll service provider will have to provide consistent and complete declarations which means that the OBE status must be checked both in terms of its position and its condition. In addition the toll charger will perform random checks along the roadside which can be performed through simple observation of number plates along with vehicle properties, time and location. ARENA suggests that a modified speed camera system might be used for this purpose.

The primary tool for checking for violations is roadside checks performed by the police or similar authority and these can be combined with the digital tachograph. Checks can also be made on transport companies by the toll charger to ensure that operations are run properly and tax declarations are made correctly. And of course it will



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What makes ARENA different?

- The business model which separates the functions of toll service provider and toll charger. This separation will open the market to independent providers and permit competition between them – a significant step unique to Sweden which will enable the EETS concept to be delivered in full.
- The adoption of 'thin-client' technology. The proposal is that the kilometre tax function is implemented in the vehicle's existing or coming ICT platforms which will enable multiple applications.
- The control mechanism will focus on the business process – more intelligence and less hardware.

be possible to compare information obtained from several systems so for instance data from the digital tachograph can be validated against data from the OBE.

The concept of control is reflected in the business model which ARENA proposes. The traditional model for road user charging is a bilateral relationship between a user and toll service provider who is also toll charger. The introduction of EETS forces an organisational separation between the toll charger and the toll service provider, given that the toll charger has to be able to handle several toll service providers. The separation changes the market opening it up to independent providers and permitting competition between them. ARENA sees that competition not merely in financial terms but in the services that are offered and suggests that allowing this competition will support the development of new, innovative and more effective solutions.

The ARENA project did not form an opinion as to which technology the Swedish system should adopt

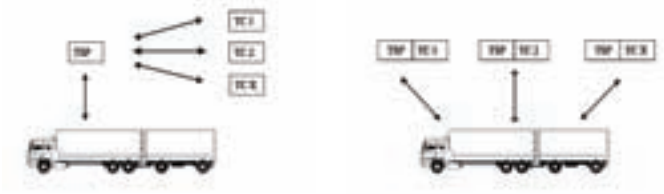

Figure 1: developing model left, traditional model right

and clearly a lot depends on what charging model is finally chosen, ie whether the whole road network is to be taxed or only certain roads. It does, however, make one or two recommendations.

The first is that Sweden should use a 'thin client'. In the German toll system, Toll Collect, the entire price list and map database are stored in each OBE (heavy client). With this solution, there are huge needs for updating each individual OBE, for example when a new country is covered, tolls changed, road standards changed or new roads built. ARENA recommends that Sweden invests in 'thin-client' technology where the functionality of the OBE is limited to registering and communicating driving information. In these circumstances mapping and route declaration would be handled by the toll service provider and the final tax calculation by the toll charger.

The other major recommendation of ARENA is that the kilometre tax function is implemented in the vehicle's existing or coming ICT platforms on the basis that positioning and communication equipment is already used to a certain degree. This compares with the German and Swiss system where it is not permissible to use the components of the OBE for anything other than tax levying. ARENA proposes that a security solution be used similar to that used in mobile phones, for instance a smartcard that is issued by the toll charger and securely and clearly identifies the OBE ad its link to a specific vehicle.

Of course, a kilometre tax based on a 'thin client' depends on the timely delivery of positions for the HGVs to the toll service provider which then handles mapping and the route declaration. In order to prevent loss of data and late deliveries, the system must be dimensioned with sufficient capacity.

ARENA has analysed the different possibilities of using existing mobile and wireless systems for both streaming and bulk transfer of position data and concluded the mobile networks in existence today would be able to handle the added load of reporting kilometre tax in Sweden with the proposed concept.

So – onto ARENA 2.0 which has practical deadlines to meet including a commitment to build a demonstration environment that can be displayed during the ITS World Congress in Stockholm in 2009. Sweden will be sending an open invitation to the demonstration in the hope that new and existing technology solutions suppliers will come along and find out whether their equipment works. The ARENA team say that this will be a learning experience and an opportunity to establish for the first time a genuine EETS environment and find out how it works. This process will start at the World Congress and will be ongoing until 2011.