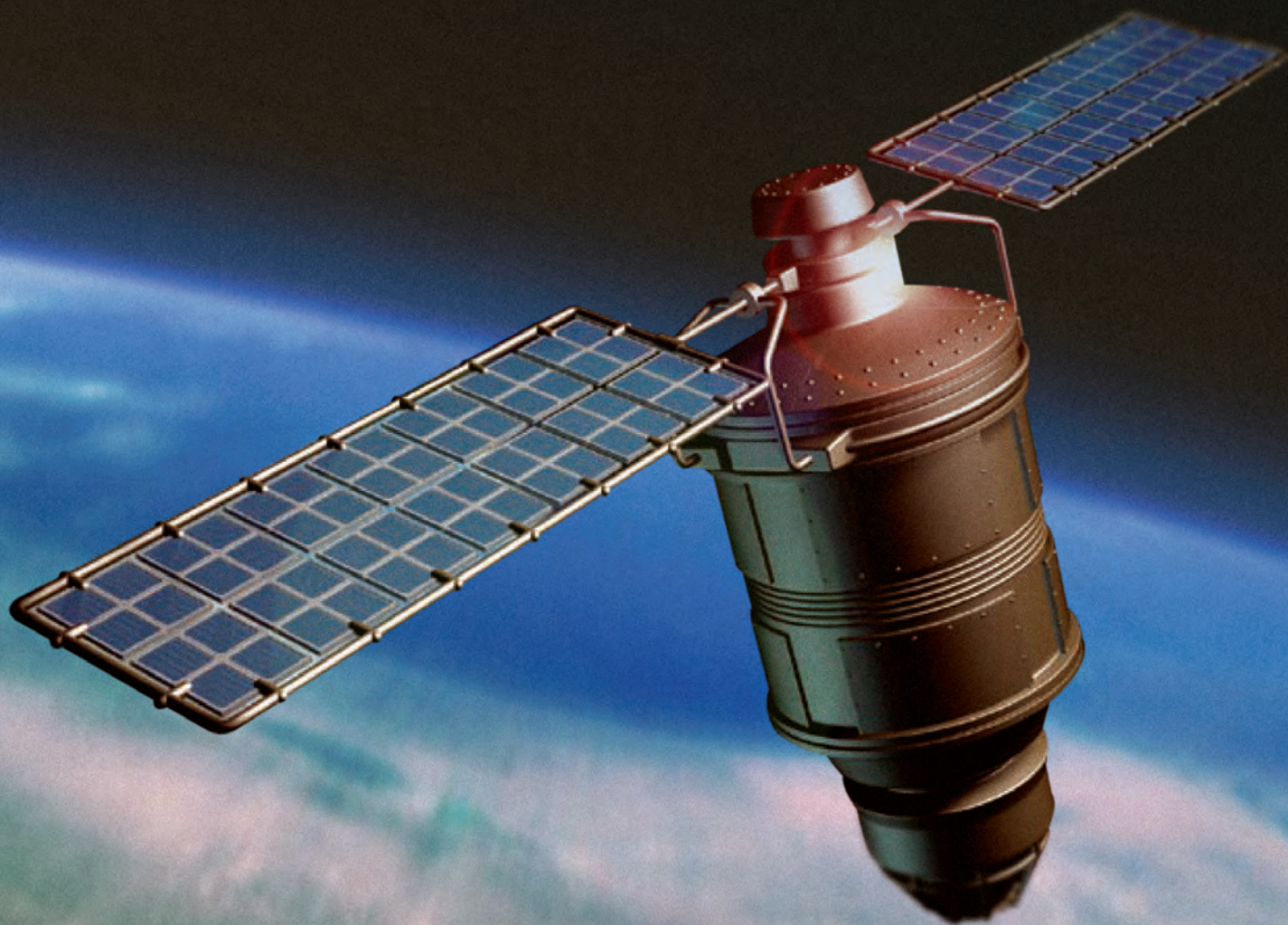


# Transport Regulatory Uses of Telematics in Europe //

Volume 2

Transport Certification Australia Limited







# Transport Regulatory Uses of Telematics in Europe Volume 2

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**List of abbreviations**

Abbreviations	Meaning
AETR	European Agreement concerning the Work of Crews of Vehicles Engaged in International Road Transport
ANPR	Automatic number plate reading
AUD	ISO 4217 currency code for Australian Dollar
CEN	European Committee for Standardization (Comité Européen de Normalisation)
CEN TC 278	CEN Technical Committee for Road Transport and Traffic Telematics
CH	ISO 3166 country code for Switzerland
CHF	Swiss franc
CZK	ISO 4217 currency code Czech Koruna
CZTT	Czech Truck Tolling Scheme
DSRC	Dedicated Short Range Communications
EC	European Commission or European Community
EEA	European Economic Area
EFC	Electronic Fee Collection
EFTA	European Fair Trade Association (Norway, Liechtenstein, Iceland and Switzerland)
EGNOS	European GPS Navigation overlay system to improve GPs accuracy and integrity
EU	European Union (Belgium, France, Germany, Italy, Luxemburg, Netherlands, Denmark, Ireland, United Kingdom, Greece, Portugal, Spain, Austria, Finland, Sweden, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia, Bulgaria, Romania)
GALILEO	European satellite positioning system, under development as an alternative to GPS
GIS	Geographical Information System (IT technology to display database information on maps)
GPS	Global Positioning System
GSM	Global System for Mobile Communications (European cellular phone technology)
HV	Heavy Vehicle (HGV, Coaches and other vehicles over 3.5 MPVW)
HGV	Heavy Goods Vehicle
LSVA	Leistungsabhängige Schwerverkehrsabgabe , Heavy Goods Vehicles Fee in Switzerland
MPVW	Maximum Permissible Gross Vehicle Weight
MPTW	Maximum Permissible Gross Vehicle Train Weight
OBU	On-Board Unit
RUC	Road User Charging
SCA	Swiss Customs Authority
UK	ISO 3166 country code for United Kingdom
TERN	Trans European Road Network
UTC	Coordinated Universal Time
VRM	Vehicle Registration Mark

## 1 Introduction

### 1.1 Telematics in traffic and transport

*Telematics* is a term that has been created to describe technologies and applications which make integrated use of *telecommunications* and *informatics*. More specifically, telematics is the discipline concerned with the transfer of data and services to mobile locations such as vehicles, containers, or people. The underlying technologies are often referred to as Information and Communications Technologies or ICT.

Telematics has its origins in military localisation applications, but the term is now mostly used as a synonym for vehicle telematics (also known as *Road Transport and Traffic Telematics* or RTTT in Europe, and *Intelligent Transport Systems* or ITS in the United Kingdom and United States).

Vehicle telematics applications are delivered through in-vehicle devices that as core technologies typically contain satellite localisation such as Global Positioning System (GPS) and cellular communications such as General Packet Radio Service (GPRS).

### 1.2 Background and scope

Transport Certification Australia Limited (TCA) commissioned Rapp Trans to provide this report on the transport regulatory uses of telematics in Europe. The objective is to give an overview of the “state of the art” concerning regulatory, i.e. governmental, uses of road transport and traffic telematics in Europe, including an expert assessment on conclusions that can be drawn regarding lessons learnt and the future potential of regulatory telematics applications.

The report is written from a European perspective, and attempts to highlight aspects of potential relevance to similar developments in Australia. The expected audience for the report is senior decision-makers who have some technical expertise.

### 1.3 Report structure

The report is made up of two volumes. Volume one provides:

- a brief overview of the traffic telematics applications currently in use in Europe as well as the policy basis for them
- a detailed description and analysis of each of the six selected regulatory applications
- an appraisal of emerging technologies under research or development in Europe including a detailed analysis of systems considered to be potential market drivers
- an assessment by the authors which seeks to help decision-makers assess the potential of the applications and to identify critical factors for success.

Volume two provides a detailed examination for each of the six selected regulatory applications, including:

- application background
- a description of the application
- a listing of associated regulatory documents.

## 2 Charging of Heavy Goods Vehicles in Europe

### 2.1 Background

#### 2.1.1 General European policy

Road pricing has been discussed in several policy statements (white and green papers) of the European Commission. In general, the papers assume that the fundamental principle of infrastructure charging is that the charge for using infrastructure must not only cover infrastructure costs, but also external costs: that is costs carried by society as a whole, including environmental costs. The question here is which external costs should be used in calculating the charges and to what extent.

##### 2.1.1.1 EC White Paper – European transport policy for 2010: time to decide

The European Commission White Paper (2001), published in September 2001 (COM 370/2001), proposed over sixty measures as part of an action plan aimed at bringing about structural improvements in the quality and efficiency of transport in Europe. It also proposed a strategy to gradually break the link between economic growth and transport growth.

Concerning the adoption of a policy on effective charging for transport, the White Paper developed two guidelines:

- Harmonisation of fuel taxation for commercial users, particularly in road transport.
- Alignment of the principles for charging for infrastructure use, whereby the integration of external costs must also encourage the use of transport modes which have a lower environmental impact (e.g. train, waterways).

##### 2.1.1.2 EC White Paper – Fair payment for infrastructure use

In its White Paper on fair payment for infrastructure use (1998), the European Commission proposed a Community approach on infrastructure charging in order to address the major shortcomings of the existing charging systems in the Member States of the EU. The basic purpose of the proposed Community approach, which is based on marginal social cost charging, is to improve the overall efficiency of the provision and use of European transport infrastructure, promote fair competition, safeguard the single market and enhance the sustainability of the transport system. The White Paper proposes a three-phased implementation of the new charging system, taking into account the different starting points of the various transport modes.

##### 2.1.1.3 EC Green Paper – Towards fair and efficient pricing in transport

According to the Green Paper (1995), internalisation of transport costs, i.e. making all users bear the full social costs of their journeys, would reduce transport problems and consequently make Europe's economy more competitive. The objective is not to increase transport costs but to encourage users and manufacturers to change attitudes in order to soften the adverse side-effects of transport.

The Commission seeks to measure all external costs arising from transport, to define methods of expressing these costs in terms of price and to propose ways of allocating these prices fairly. The objective is to introduce a fair and efficient pricing system, bringing prices closer to the real costs.

The Green Paper states that efforts to find a pricing system for transport must take account of the twin concepts of equity and efficiency. Any assessment must ensure equitable conditions of competition within and across modes on the internal transport market.



Although local or regional authorities are often best suited to deal with transport-related problems, European action may be justified to deal with supranational externalities or the effects on the internal market and to capitalise on possible economies of scale and policy overlaps.

### 2.1.2 Treaty of the European Community

The Treaty of the European Community (European Treaty of Nice) and the Eurovignette Directive have a major impact on RUC systems in Europe. In particular, two principles are of outstanding importance: the equal treatment of all users and the absence of fiscal barriers to trade.

The fundamental principles are laid down in Part 1 of the Treaty (especially Art. 13 and 14) and are detailed in Part 3, the Community Policies. Part 3, Title V, on Transport states:

- in Art. 75.1 “In the case of transport within the Community, discrimination which takes the form of carriers charging different rates and imposing different conditions for the carriage of the same goods over the same transport links on grounds of the country of origin or of destination of the goods in question shall be abolished.”
- in Art. 76 .1 “The imposition by a Member State, in respect of transport operations carried out within the Community, of rates and conditions involving any element of support or protection in the interest of one or more particular undertakings or industries shall be prohibited, unless authorised by the Commission.”
- in Art. 77 “Charges or dues in respect of the crossing of frontiers which are charged by a carrier in addition to the transport rates shall not exceed a reasonable level after taking the costs actually incurred thereby into account.”

These principles apply to all European legislation and can be found, for example, in the Eurovignette Directive in Art. 7 paragraphs 4 and 5 (see next section).

Equal treatment of all users means that if two users use the same road under the same conditions (especially same vehicle category and same time of day), they shall pay the same charge. This requirement is absolute, non-negotiable and exact. In practice it means for RUC systems that users have to be treated equally, irrespective of which technical solutions they use. Frequent users will most likely use some form of electronic on-board equipment, whereas occasional users will be offered a less sophisticated option for payment, for example a paper ticket. Irrespective of whether a user is equipped with an OBE or uses a manual system access, it must be ensured that the user always pays exactly the same. For example, it is not possible to charge equipped users with a correct kilometre-dependent tariff and to charge occasional users with a simple lump-sum day pass. This interpretation of the Treaty and of the Eurovignette Directive was confirmed by the Commission when Austria and Germany presented the detailed scheme design of their heavy vehicle fee collection systems.

The “absence of fiscal barriers” is the second principle of European law, and has a major impact on road charging systems. European law requires that there shall be no barriers to free trade. Foreign companies shall have the same access to the market as national ones. For RUC systems this means that it is important that the charge does not interfere with the free movement of goods and services. The most critical aspect in this respect is system access.

The principles of European law of equal treatment and of absence of barriers to free trade are important and decisive constraints for charging systems. These principles have an especially high impact on the solutions for foreign and for infrequent users.

### 2.1.3 Eurovignette Directive

The Directive 1999/62/EC of 17 June 1999 on “the Charging of Heavy Goods Vehicles for the Use of Certain Infrastructures” applies, according to its last revision in 2006, to heavy goods vehicles above 3.5 t.

The Directive differentiates between the TERN road network, where charging is subject to the conditions laid out in Directive, and other roads, which may be charged according to national regulations.

It requires that every Member State shall have an annual heavy goods vehicle tax for national users at least as high as specified in the Directive. For road charges that apply to all users, the Directive allows for two variants:

- Time dependent road charges. These shall be limited to a tariff given in the Directive.
- Distance dependent charges. These charges shall depend on the distance travelled and on the vehicle type. Regarding the tariff, the Directive states that “the weighted average tolls shall be related to the costs of constructing, operating and developing the infrastructure network concerned”. In environmentally sensitive areas the fee can be increased by 15%.

The fact that time dependent road charges like annual or monthly paper stickers (vignettes) are limited by the Directive has triggered some countries, especially Austria, Germany and Czech Republic, to introduce distance dependent charges that allow for much higher tariffs.

### 2.1.4 Interoperability Directive

Directive 2004/52/EC on the interoperability of electronic road toll systems in the community defines the technologies of electronic toll systems brought into service after the 1 January 2007. It was adopted in April 2004. A detailed appraisal regarding this important Directive is given in this volume in the section on European Electronic Toll Service (EETS).

## 2.2 Charging of Heavy Goods Vehicles in Europe

Presently there are four nationwide electronic tolling schemes for HGV in operation using different charging principles and technological approaches. These are Austria (2004), Czech Republic (2007), Germany (2005) and Switzerland (2001).

Each single scheme is explained in more detail in the following chapters. A comparative section then gives a brief comparison of the core design elements and of the existing variety of factors in determining the basis of the charges.

### 2.2.1 LKW-Maut Austria

#### 2.2.1.1 Background

The Federal Highways Financing Act of 1996 and the Austrian Infrastructure Financing Law of 1997 gave ASFINAG, a state-owned company and executive of the Federal Ministry of Transport, Innovation and Technology, the power to collect distance-based tolls on the highly developed sections of the Austrian road network and to spend the income solely on road and rail related projects.

Officially, the motivation for introducing a distance-based charging system for heavy vehicles was the desire to attribute costs more fairly according to use, but actually was the urgent need for income in order to serve the huge debts that ASFINAG has accumulated in the period where Austria's high-level road network was built. Since the Eurovignette Directive severely limits time dependent charges, Austria decided to move to distance dependent tolling in order to be able to raise more revenue.

The Austrian federal road network, comprising of approximately 2045 kilometres of motorways and expressways, is covered by the new scheme. All vehicles exceeding 3.5 t gross laden weight are subject to the charges. Classification is based on the number of axles (2, 3, 4+). Tariffs per kilometre are €0.13 (AUD 0.22) for vehicles with 2 axles, €0.182 (AUD 0.31) for vehicles with 3 axles and € 0.273 (AUD 0.46) for vehicles with 4+ axles. The total revenue in 2006 was around €825 million (AUD 1354 million).

Operation started on 1 January 2004. As the government-owned financing and operating company for motorways and expressways, ASFINAG procured the services of EUROPPASS, a private company owned by the Italian motorway concessionaire Autostrade per l'Italia, to erect and operate the toll collection system for ten years. In August 2005 (retroactive to the 1 January 2005) ASFINAG pulled the contractual fixed call-option and took over the ownership and control of EUROPPASS.

There are several other charging schemes which interact to varying degrees with the new system. Austria has for some time operated a paper-based vignette system covering the entire motorway and major roads network. The vignette is a piece of paper which is displayed in the windscreen and is valid for a specified time period. All light vehicles are still subject to this time-based charge. For vehicles over 3.5 t the new distance-dependent charging scheme replaced the former time-based vignette.

In addition to the vignette, there are four motorway sections with long tunnels which are subject to local tolls, justified on the basis of the exceptional construction costs: A9 Gleinalm, A10 Tauern, A13 Brenner, and S18 Arlberg. All vehicles are subject to tolls on these links. In due course the toll stations will be integrated with the new charging scheme for vehicles over 3.5 t.

### 2.2.1.2 Scheme Solution

#### Tolling Scheme

All eligible vehicles must be fitted with an OBU (a transponder called GO-Box) which is attached to the windscreen. The vehicles are charged as they pass under gantries which are mounted on each of the 800 charged links. Figure 1 shows a gantry and Figure 2 a GO-Box transponder.



Figure 1: Tolling gantry in Austria



Figure 2: Austrian OBU GO-Box

The scheme operates as a "non-stop" electronic charging system in that there are no barriers. It is the first national, multi-lane, free-flow tolling system worldwide. Each gantry carries an array of microwave beacons. One hundred gantries are additionally fitted with enforcement equipment, such as cameras and laser scanners.

All eligible vehicles are required to have an OBU; there are no provisions for non-equipped vehicles. There are various ways for hauliers to obtain an OBU. Fuel card companies are offering fleet owners assistance in opening accounts and getting the OBUs. OBUs are also available at approximately 170 kiosks and 47 self-service machines. There is an extensive network of kiosks, mostly at petrol stations, both on the motorway and nearby. Drivers are offered both Pre- and Post-Pay accounts and may use fuel cards and credit/debit cards, as well as cash.

The system uses 5.8 GHz microwave DSRC compliant with the European standards (the same as used in Australia). Achieving the greatest possible degree of interoperability with different toll systems in Europe (particularly Austria's neighbouring countries) was considered to be an important aim of the scheme.

#### Enforcement

There are 100 fixed enforcement stations plus 20 portable gantries and mobile units used for enforcement. The 20 portable units can be used to temporarily change any of the 800 charging gantries into an enforcement station. The mobile units are specially equipped vehicles operated by ASFINAG and cover the entire network. Figure 3 shows one of the fixed enforcement stations used in Austria.



Figure 3: Fixed enforcement station in Austria

### 2.2.1.3 Procurement Strategy

An important part of ASFINAG's procurement strategy was to contract a turn-key supplier for the entire tolling scheme, with ASFINAG mainly fulfilling a strong review and steering function. As a result, only 89 functional requirements were formulated in the tender documents but no detailed technical specifications.

The tender was open, and public with the following main requirements:

- no obstruction of traffic flow by the collection of the Heavy Vehicle fee
- all vehicles above 3.5 t maximum permissible weight are subject to a toll fee
- whole motorway network is subject to the toll (including existing toll stations) - total network length 2112 km
- free choice of tolling technology for the operator
- no discrimination against occasional users
- open tolling system, i.e. that charges shall be paid on the network sections, and not on entry or exit
- effective and efficient enforcement
- no plans for tolling of passenger cars.

The two main project-management tools of ASFINAG were:

- project organisation with steering-committee and several project groups
- rigid project change management process.

The establishment of a common steering committee and several common project groups was an integral part of the contractual agreement with the turnkey supplier EUROPPASS. In response, EUROPPASS set-up a project organisation reflecting the defined project groups outlined in the tender documents.

## 2.2.2 LKW-Maut Germany

### 2.2.2.1 Background

In 1995, the German Minister for Transport announced the introduction of a distance based HGV-toll. In 1998, the German government decided to implement a so called “anti-congestion programme” by introducing tolls on the roads. The Minister for Transport announced the introduction of the distance based HGV-toll from 2002. The tolling system would be financed, installed and operated by a private company.

In 1999, the German government called an expert commission to evaluate the possibilities for financing German roads from sources other than the federal budget, such as road tolls. The commission was led by Wilhelm Pällmann, former chairman of the German Railways and German Post and Telecom. The report was presented a year later in 2000. The commission recommended introducing a distance dependent toll for the use of motorways and main roads.

In August 2001, the German government decided to introduce a distance based motorway toll for HGVs with a maximum permissible weight of over 12 t. The tariff, dependent on the number of axles and emission class, was set to be between 14 and 19 €cent per kilometre. The law was introduced in April 2002 and is the legal basis for the German HGV toll.

All vehicles with a permissible weight of 12 t and above which are exclusively intended for use in transporting freight pay a toll based on the distance travelled on the motorway network in Germany. The new tolling scheme was introduced on 1 January 2005, after two postponements because of technical problems, and replaced the paper-based Eurovignette scheme.

On 1 January 2005 the system went into operation with a limited technical functionality but with the assurance of the correct toll collection. On 1 January 2006 the system acquired its full technical functionality (possibility of remote software update of the OBU etc.) by means of a software release change that required all vehicles to visit a workshop.

The charge is an average of €0.12 (AUD 0.20) per kilometre. In mid 2007 the average charge will increase to €0.13 (AUD 0.22) per km. During 2006 a total of €3080 million was collected (AUD 5 billion).

Drivers have several options for booking journeys and for making payments. Journeys may be pre-booked by means of the internet, a call-centre (provided by independent service companies), or at one of 3,700 terminals situated on or close to the motorway network. Alternatively, drivers may obtain an OBU which calculates the charge automatically.

Since 1 January 2007, three additional ordinary roads (Bundesstrassen B4, B9, and B75) have been added to the charged road-network. This measure was mainly necessary due to the massive “detour-traffic” of HGV using the ordinary roads to avoid the charge on the motorways.

The length of the tolled road network is about 12,750 kilometres, with:

- 2700 motorway entry / exit points
- 251 motorway interchanges
- about 5400 tolled sections.

### 2.2.2.2 Scheme Solution

#### Tolling Scheme

There is a Dual Toll Collection System with a **Main Scheme** solution using an OBU and an **Occasional User Scheme** requiring a manual journey booking. There is free choice between the schemes.

#### Main Scheme

Users can obtain an OBU free of charge. The costs of installing (and eventually removing) the OBU must be carried by the vehicle owner. An extensive network of 1,850 service outlets is available to fit the units.



Figure 4: Radio-slot sized Toll Collect OBU



Figure 5: Dashboard mounted Toll Collect OBU

The OBU will automatically login and register journeys on the motorway network. The equipment incorporates a motorway map, satellite positioning (GPS) and a tachograph connection. There are also gyroscopes to detect vehicle movement and turns. This equipment monitors the position of the vehicle and recognises when it is passing a virtual toll gantry. Once on the charged network, the unit identifies each motorway link subject to toll and determines the length by reference to the in-vehicle map.

The OBU also includes an infra-red DSRC link for enforcement purposes and to support the positioning of the vehicle in areas with insufficient GPS coverage. Motorway segments that are not reliably identifiable with GPS are equipped with assistive beacons that communicate the segment number to the OBU by means of infra-red DSRC. Currently about 180 fixed infrared beacons have been installed. These are at crucial locations, for example where a non-tolled road is parallel to the tolled motorway. An extra 30 portable infrared beacons are available for temporary use at construction sites, for example contra flow situations. These beacons are autonomous, with independent communications and solar panels used for energy supply.

To support potential interoperability needs (but not yet in use), the OBU includes a microwave DRSC module compliant with CEN TC 278 standards.

The OBU calculates the toll based on preset vehicle parameters (number of axles, weight, and emission class), rate information and the number of kilometres travelled. The calculated toll for every motorway segment is shown on the display of the OBU. A GSM cellular network phone connection is used by the OBU to send charge information to the back office.



There are two types of OBU available, and placement of the OBU varies according to the type of vehicle. One unit can be installed in a slot in the vehicle's dashboard (DIN slot) if available (Figure 4). The other sits on top of the vehicle's dashboard (Figure 5). The Vehicle Registration Mark (VRM) of the vehicle is registered in the unit at time of issue. Users receive instructions and a PIN number which must be entered to indicate that they have read and understood their obligations.

A total of 300,000 OBUs were installed by start of operations. At the time of preparing this report about 542,000 OBUs have been fitted: 352,300 in domestic vehicles and 189,700 in foreign vehicles.

### Occasional User Scheme

Users without an OBU can book a trip in advance by:

- manual logon at over 3700 toll collection terminals
- login via internet
- indirectly by call centres of dedicated service providers (the EFC system operator Toll Collect does not offer this service directly).

The logon (charging) process requires the following information:

- Vehicle Registration Mark (VRM) of the vehicle
- the route subject to tolls to be driven
- date and time for the start of the journey
- number of axles of the vehicle
- vehicle emission category.

A smart-card holding fixed vehicle data is issued at registration and can be used to speed up the logon process at the terminals.

Figure 6 shows a manual logon point with the terminals used for the German occasional user scheme.



Figure 6: Manual logon point with terminals used for the German occasional user scheme



## Enforcement

There are 300 fixed enforcement stations and around 280 mobile enforcement units. These are able to confirm that an OBU is fitted and working correctly, or to capture the VRM of the vehicle and to check this against a central database of registered journeys. The Federal Office of Goods Transport (Bundesamt fuer Gueterverkehr, BAG) also carries out spot checks at company premises.

Figure 7 shows a fixed enforcement station used in the German motorway tolling scheme (single gantry arrangement).



Figure 7: Fixed enforcement station used in the German motorway tolling scheme

### 2.2.2.3 Procurement Strategy

The German procurement strategy covered a two-phase procurement process, with an open pre-qualification followed by an invitation to negotiate for a limited number of bidders.

According to a statement from the German Ministry of Transport:

“Germany will become a technical precursor of a widely automated HGV toll collection system. This will launch new market opportunities for the industry and secure jobs. The worldwide first-time realisation of such a system can initiate an investment boom in other fields of information technologies.” (Bundesministerium für Verkehr, Bau- und Wohnungswesen, Fakten zur LKW-Maut, 2003-2004)

It is clear that the choice of system was influenced by the decision of the European Commission to choose the GALILEO satellite system for future tolling technologies.

## 2.2.3 Czech Truck Tolling Scheme

### 2.2.3.1 Background

The Czech federal road network (approximately 970 kilometres of road network comprising of motorways and expressways) is covered by the new scheme. All vehicles or vehicle combinations which could exceed 12 t gross laden weight are subject to the charges. Classification is based on the number of axles (2, 3, 4+) as well as on the emission class (EURO 0-2, EURO 3-5).

Tariffs per kilometre vary from CZK 1.70 (AUD 0.10) to CZK 5.40 (AUD 0.32). Expected total revenue is around €100 million per year and operation started on 1 January 2007.

For vehicles between 3.5 t and 12 t a vignette-system is in use.

### 2.2.3.2 Scheme Solution

#### Tolling Scheme

The use of an OBU is mandatory for all vehicles liable to toll. The OBU enables access to the electronic toll collection using DSRC technology. Following the instructions provided, users can fit the OBU themselves; there is no requirement for specialist tools or knowledge (Figure 9).



Figure 8: Tolling gantry in Czech Republic



Figure 9: Czech OBU Premid

The scheme operates as a non-stop electronic charging system with no barriers. It is a multi-lane, free-flow tolling system. Each of the 178 overhead gantries (Figure 8) is mounted with an array of microwave beacons, and 37 sections are fitted with enforcement equipment (cameras and laser scanners).

All eligible vehicles are required to have an OBU. There are no provisions for non-equipped vehicles. There are various ways to obtain an OBU. Fuel card companies are offering fleet owners assistance in opening accounts and obtaining the OBUs and OBUs are also available at 200 distribution points and 14 contact points. Drivers are offered both Pre- and Post-Pay accounts and may use fuel cards and credit/debit cards, as well as cash.

The system uses 5.8 GHz microwave DSRC compliant with CEN standards. Achieving the greatest possible degree of interoperability with different toll systems in Europe (particularly Czech Republic's neighbouring countries) was considered to be an important aim of the scheme.

## Enforcement

A total of 37 toll-sections are equipped with fixed enforcement stations. One portable gantry and approximately 30 mobile units are also used for enforcement purposes. The portable unit can be used in combination with any charging gantry to turn it into an enforcement station. The mobile units cover the entire network and are operated by Czech Customs Authority.

### *Enforcement Stations*

Enforcement stations automatically identify toll violators, whether the violation is due to absence of an OBU, a false declaration of vehicle class, being black listed, or having a low balance on the OBU. Enforcement stations cover all lanes of traffic without disrupting traffic flow.

### *Portable Enforcement Stations*

Tolling stations can be equipped with portable enforcement equipment enabling random automatic enforcement checks on the tolled road. The portable equipment works like a fixed enforcement station, but is limited to one lane. Portable enforcement equipment can be installed on every toll section on the tolled road to combat systematic fraud. The equipment makes use of the infrastructure already available at tolling stations.

### *Mobile enforcement units*

Mobile Enforcement Vehicles are used by Czech Customs to make compliance checks in moving traffic or at stationary points (fuel stations, parking places, etc.) with GSM/GPRS connection to the enforcement centre which is part of the central system. The Mobile Enforcement Vehicles can be equipped with OBU readers enabling the agents to check vehicles they pass (Figure 10).



Figure 10: Mobile Enforcement Vehicle in Czech Republic

### 2.2.3.3 Procurement Strategy

In 2004 the Czech Transport Ministry launched a Call for Tenders for a Tolling Consultant to RSD, the Czech Road Administration. RSD was in charge of preparing a tender for the Implementation of a Truck Tolling Scheme on motorways and selected ordinary roads. Due to very narrow requirements only one expression of interest was entered and the contract was awarded to a consortium consisting of Deloitte CZ and Bovis.

Approximately one year later, the Czech Transport Ministry and RSD launched the procurement of the tolling scheme operator. The procurement was published in the EU official gazette at the end of June 2005 and the tenders had to be submitted by end of September.

Ultimately only four offers were submitted. The four consortia were:

- Ascom/Fela/Damov ABD (509m Euro, 850m AUD)
- Autostrade (593m Euro, 990m AUD)
- Kapsch / PVT (746m Euro, 1.25bn AUD)
- Konsortium A-WAY/AZD (1,1bn Euro, 1.84bn AUD).

German companies like Siemens or T-Systems did not submit an offer due to the “unacceptable” requirements.

During the evaluation of the tenders, three of the four offers were eliminated on formal grounds. The contract was awarded to the consortium Kapsch/PVT in mid-November. The bidding consortia Ascom/Fela and Autostrade objected to the decision and the following legal dispute postponed the signature of the contract for several months. In March 2006 the Czech “anti-monopole authority” (UOHS) rejected all claims and confirmed the Kapsch/PVT consortium as the winner of the procurement. The contract was finally signed on 29 March and the implementation by Kapsch could officially start.

In October 2006 additional complaints by Autostrade led to a preliminary injunction and all ongoing work on the implementation was stopped for a week. Again, the district court in Brno rejected complaints and Kapsch continued the roll-out.

The scheme successfully started operation on 1 January 2007, but the implementation of a second phase, covering secondary roads, was postponed until 1 July 2007. At the beginning of February 2007 it was announced that the second phase would be further delayed and would not be implemented until 1 January 2008.

## 2.2.4 Heavy Vehicles Fee Switzerland

### 2.2.4.1 Background

The Swiss Heavy Vehicle distance based charging system, LSVA, was introduced on 1 January 2001 as a result of the predicted increases in heavy goods vehicle traffic passing through Switzerland, in particular along the German-Italy and Italy-France corridors. One objective was to limit the increase in traffic when the national weight limit was increased from 28 t to 34 t in 2001 and to 40 t from 2005 onwards. Another objective was to encourage a modal shift from road to rail for transalpine goods transport. Money raised from the scheme is primarily being used to finance new railway tunnels through the Alps.

The principles of the scheme are:

- The charge involves all HGVs over 3.5 t gross laden weight.
- The vehicle is charged by distance travelled on all roads (including private roads, yards, manoeuvring) in Switzerland and in the Principality of Liechtenstein.
- The charge is based on maximum permissible laden weight of the total vehicle train (not on the actual weight).
- The tariff depends on the emission category of the HGV.
- The charge replaced a flat, time-based charge.

The owner of the vehicle and, for foreign vehicles only, the driver of the vehicle, is liable for the tax (joint several liability).

The scheme is operated by Swiss Customs Authority and started operation on 1 January 2001.

### 2.2.4.2 Scheme Solution

#### Tolling Scheme

LSVA operates two schemes: a Main Scheme which is compulsory for Swiss vehicles and optional for foreign vehicles, and an Occasional User Scheme for remaining vehicles. Out of almost 500,000 registered foreign vehicles, less than 2,000 are Main Scheme users.

#### *Main Scheme*

The Main Scheme uses an OBU. The OBU is provided free of charge, although the costs of installation must be covered by the vehicle owner. Figure 11 shows a beacon arrangement at the Swiss border. Figure 12 shows an OBU.



Figure 11: DSCR Beacons at a border station



Figure 12: SWISS OBU "Tripon"

The OBU of the Swiss LSV system records trip data automatically. The kilometres driven on Swiss territory are recorded by means of an electrical connection to the tachograph. Recorded distance is verified with a satellite positioning system (GPS) and a movement sensor to ensure the tachograph information is within legal tolerances. A DSRC link is used at the border to start and end distance measurement on Swiss territory. For this purpose, the border stations are equipped with 5.8 GHz microwave DSRC beacons compliant with CEN standards. The DSRC transaction over the air link is designed with European interoperability in mind. The automatic enforcement stations have an automatic number plate reading (ANPR) system as well as microwave DSRC.

Domestic Main Scheme users are required to make a monthly declaration. This is done by inserting a chip-card into the OBU. The OBU then writes the latest usage information to the card. The card is removed and the data are sent to the Central System either via the Internet by means of a card reader attached to a computer, or by sending the card via normal surface mail. Foreign Main Scheme users upload the charging data when they leave Switzerland via the DSRC link at the border stations.

In 2004, the procurement of a second generation of OBU for the heavy vehicle fee was started. The Swiss Customs Authority has defined the next steps for its distance-related heavy vehicle charge OBU, called CH-OBU-2. It signed a contract with Siemens Switzerland in September 2006, which set out milestones for the further course of action.

In 2007 the project entered its implementation phase. The start of the component tests, in which the functions of the individual components will be tested, was scheduled for September 2007. Subsequently, the start of integration tests are scheduled for January 2008 to ensure that the individual components in the overall system of the distance-related heavy vehicle charge will work optimally.

From summer 2008 onwards, a productive field test is planned. This represents the inauguration - to a limited degree - of the distance-related heavy vehicle charge IT system. The new system will be fully tested using approximately 1000 vehicles. If all goes well, the mass production of the new OBU will start in December 2008. The two-year refitting period of Switzerland's TRIPON (OBU-1) to the new version (OBU-2) is scheduled to start in spring 2009.

The technical structure of the OBU-2 will include an interoperable DSRC interface for possible use in Austria, France, Slovenia, Spain and Portugal. By implementing the proprietary Italian Telepass function, it should also be possible to use the CH-OBU-2 in Italy.



### *Occasional User Scheme*

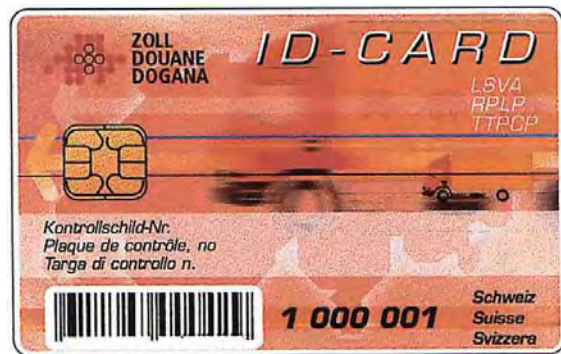
The overwhelming majority of foreign drivers do not opt for the Main Scheme but instead use identification cards and self-service terminals located at the border stations. When entering Switzerland for the first time, vehicle data relevant for the calculation of the LSVA are registered in the central computing system, and a vehicle-specific ID card (see Figure 14) is handed to the driver. With each subsequent entry to Switzerland, the driver inserts this card into a reader in a self-service terminal and manually enters the following journey specific data:

- actual mileage on the tachograph when entering Switzerland
- trailer presence and trailer maximum permissible weight
- preferred payment means (cash or fleet/petrol cards).

The terminals are installed at 100 customs stations and are straightforward to use, utilising a simple dialogue structure on the terminal screen. Figure 13 shows self-service terminals at the motorway border station Basel/St. Louis.



**Figure 13: Self service terminals at the Swiss border**



**Figure 14: ID-Card for LSVA**

The driver receives two copies of the receipt which they then complete with the new (actual) mileage and sign when leaving the country. Cash payments can be made directly at the Customs offices. Customs conduct random checks on the declared data at border crossings.

## Enforcement

Enforcement involves spot-checks at borders, together with twenty-one fixed enforcement stations installed on motorway sections throughout Switzerland. A prototype mobile enforcement unit is also already in operation. An example of a fixed enforcement station can be seen in Figure 15.



Figure 15: Fixed (pilot) enforcement station in Switzerland

### 2.2.4.3 Procurement Strategy

Initially, the Swiss Federal Roads Authority was in charge of the development of the OBU prototypes. However when it became clear that Swiss Customs Authority would play a leading role in the operation of the system, the project lead was transferred to them.

The strategy of the Swiss Customs Authority was to tender and order parts directly from industry according to its specific needs and not to allocate the responsibility to a general contractor or turn-key supplier.

Calls for tenders were issued for specific bundles of infrastructure or hardware and not for the entire EFC-system. Due to the specific needs for integration of the IT into the existing Customs Authority IT system, the supporting central system was developed by an in-house IT department with some external support.



The specific procurement bundles were:

- on-board units (OBU; AUD 100m)
- road-side equipment / Beacons (AUD 30m)
- self service terminals for occasional user scheme (AUD 10m)
- enforcement system (AUD 25m)
- back-office application / Central System (in-house)
- plus some minor tenders.

This strategy was chosen by the Swiss Customs Authority because of its responsibility for implementing the system on time. It could choose the best offers for each specific task. Due to direct contact with each supplier, the implementation phase was very efficient, avoiding indirect communication through a general contractor. As the Swiss Customs Authority was fully responsible for the implementation of the project, it was able to drive activity towards its main goal – starting on-time – and not waste time or money in legal disputes or on technical details with its suppliers when problems or design changes arose.





## 2.3 Schemes comparison





Considerable differences in charging principles, liable vehicles, and charging parameters can be observed across the four nationwide EFC schemes implemented in Europe for heavy goods vehicles.

### 2.3.1 EFC scheme design elements and legal base

The charging principle is mainly driven by policy decisions during the political discussion phase of the implementation of a nation-wide scheme. Table 1 gives an overview of the existing charging principles and design elements across Europe.

**Table 1: Charging principles across Europe**





	Austria	Czech Republic	Germany	Switzerland
				
TITLE OF SCHEME	GO Mautsystem für LKW und Bus GO bus and truck tolling system	Premid / MYTO CZ Czech Truck Tolling System	Toll Collect LKW-Maut Deutschland Toll Collect Heavy Goods Vehicle Toll on German Motorways	Leistungsabhängige Schwerverkehrsabgabe (LSVA) Distance related Heavy Vehicle Fee (HVF)
START OF OPERATION	1 January 2004	1 January 2007	1 January 2005	1 January 2001
CHARGED ROADS	All motorways and selected expressways in Austria	Phase 1: All motorways and expressways in the Czech Republic Phase 2 (from 1 January 2008) Selected ordinary roads	All motorways (with exemption of some sections) Since 1 January 2007 additionally three sections of ordinary roads (Bundesstrasse)	All roads in Switzerland
LIABLE VEHICLES	All Heavy Vehicles with a MPVW over 3.5 t All vehicles exceeding 3.5 t gross laden weight are subject to the charges. MPVW: Maximum Permissible Gross Vehicle Weight MPTW: Maximum Permissible Gross Vehicle Train Weight	All Vehicles with MPVW of 12 t or above and Vehicle combinations with MPTW of 12 t or above	Heavy Goods Vehicles with MPVW of 12 t or above and Heavy Goods Vehicles combinations with MPTW of 12 t or above	All Heavy Goods Vehicles with a MPVW over 3.5 t
CHARGING PRINCIPLE	Distance and number of axles	Distance, number of axles and emission values	Distance, number of axles and emission values	Distance, weight and emission values
OBJECTIVES OF CHARGING	The LKW-Maut aims to: Guarantee the financing of extension, operation and maintenance of the Austrian motor and expressway network	The Czech Truck Toll aims to: Guarantee the financing of extension, operation and maintenance of the Czech motor- and expressway network	The LKW-Maut aims to: Establish the user pays principle to charge the real cost to the user Create additional revenue for financing of extension, operation and maintenance of the German motor- and expressway network Promote fair competition for rail and waterways mode for goods transport Improve the efficient use of HGV Promote innovative technology	The LSVA aims to: Be an incentive for the transfer of goods traffic from road to rail Finance of the new railway infrastructure, in particular the new railroad tunnels through the Alps Internalisation of external transport costs

	Austria	Czech Republic	Germany	Switzerland
				
LEGAL BASE	<p>The legal bases for implementation of the LKW-Maut are:</p> <ul style="list-style-type: none"> <li>• Bundesstraßenmautgesetz (BSiMG) [Federal Road Toll Act]</li> <li>• Mautordnung für die Autobahnen und Schnellstrassen Österreichs [Motorway Tolling Regulation]</li> <li>• Maut-Inbetriebnahmeverordnung [Regulation about Start of Operation]</li> <li>• Mauttarifverordnung [Toll Tariff Regulation]</li> <li>• Mautstrecken-Ausnahmenverordnung [Ordinance on Toll Segments Exemptions]</li> </ul> <p>For informal use, the Austrian Motorway Tolling Ordinance can be down-loaded in English under from <a href="http://www.asfinag.at">www.asfinag.at</a></p>	<p>The legal bases for implementation of the CZ truck toll are:</p> <ul style="list-style-type: none"> <li>• Act No. 13/1997 Coll., on Land Communications, as amended by Act No. 80/2006 Coll</li> <li>• Edict 527/2006 Sb, on use of tolled roads and on change to edict no. 104/1997 Coll., which implements the Road Traffic Act, as amended by later regulations</li> <li>• Czech Government Regulation Nr. 484/2006 Sb</li> </ul> <p>Additionally:</p> <ul style="list-style-type: none"> <li>• General Terms and Conditions of Operator of Electronic Toll Collection System effective from 1 January 2007</li> </ul>	<p>The legal bases for implementation of the LKW-Maut are:</p> <ul style="list-style-type: none"> <li>• Gesetz über die Erhebung von streckenbezogenen Gebühren für die Benutzung von Bundesautobahnen mit schweren Nutzfahrzeugen (Autobahnmautgesetzes, ABMG) [Motorways Toll Act]</li> <li>• Verordnung zur Erhebung, zum Nachweis der ordnungsgemäßen Entrichtung und zur Erstattung der Maut (Lkw-Maut-Verordnung - Lkw-MautV) [HGV Toll Regulation]</li> <li>• Verordnung zur Festsetzung der Höhe der Autobahnmaut für schwere Nutzfahrzeuge (Mauthöheverordnung - MautHV) [HGV Tariff Regulation]</li> <li>• Mautstreckenausdehnungsverordnung, issued on 17 Dec 2006 (govern the charging on sections of ordinary roads).</li> </ul>	<p>The legal bases for implementation of the LSVA are:</p> <ul style="list-style-type: none"> <li>• Article 85 of the Swiss Constitution which provides a legal basis for the implementation of the LSVA</li> <li>• Schwerverkehrsabgabegesetz, (SVAG) [Heavy vehicle fee act] and</li> <li>• Schwerverkehrsabgabeverordnung (SVAV) [Heavy vehicle fee Ordinance]</li> </ul> <p>Additional Ordinances are available for special regulations.</p>

### 2.3.2 Determination of charge

Last but not least, the basis of the charge varies considerably across Europe. Table 2 gives an overview of the charge determination.

**Table 2: Determinations of charge across Europe**

	Austria	Czech Republic	Germany	Switzerland
				
WEIGHT	None Only in context with liability	None Only in context with liability	None Only in context with liability	Yes <b>Tariff factor</b> , MGWV of rigid vehicle resp. MGTW of vehicle combination
DISTANCE	Length of tolled road section used by the liable vehicle	Length of tolled road section used by the liable vehicle	Length of tolled road section used by the liable vehicle	<b>Tariff factor</b> , taken from odometer either by connected OBU or manual declaration on a form
NUMBER OF AXLES OF VEHICLE	There are 3 different tariff categories defined: <ul style="list-style-type: none"> <li>• Category 2: vehicle with 2 axles</li> <li>• Category 3: vehicle with 3 axles</li> <li>• Category 4: vehicle with 4+ axles</li> </ul>	There are 3 different categories defined: <ul style="list-style-type: none"> <li>• Category 1: vehicle with 2 axles</li> <li>• Category 2: vehicle with 3 axles</li> <li>• Category 3: vehicle with 4+ axles</li> </ul>	The differentiation of axles is split: <ul style="list-style-type: none"> <li>• Up to 3 axles</li> <li>• 4 or more axles</li> </ul>	Only Indirect: Trailer declaration including Correct MGWV
EMISSION VALUES	None	Yes Emission values define the tariff which is based on the nr. of axles The categories are: <ul style="list-style-type: none"> <li>• EURO class 0,1,2</li> <li>• EURO class 3,4,5</li> </ul>	Yes Emission values define the tariff which is based on the nr. of axles The categories are: <ul style="list-style-type: none"> <li>• Category A: Emission class S4, S5, EV1</li> <li>• Category B: Emission class S3,S2</li> <li>• Category C: Emission class S1</li> </ul>	Yes <b>Tariff (factor)</b> Emission values define the tariff The categories are: <ul style="list-style-type: none"> <li>• Category 1 EURO class 0 &amp; 1</li> <li>• Category 2 EURO class 2</li> <li>• Category 3 EURO class 3, 4 or later</li> </ul>
DETERMINATION OF CHARGE	Fix amount per tolled road section according to nr. of axles	Fix amount per tolled road section according to nr. of axles and emission values	Fix amount per tolled road section according to nr. of axles and emission values	Formula: Distance covered in Switzerland * Weight * Tariff based on Emission Values
SPECIAL REGULATIONS	Coach trailers are not subject to charge and therefore not taken into account.	Coach trailers are subject to charge	-	For vehicles exclusively used for the transport of milk, logs/raw wood and living animals

## 2.4 Regulatory documents

### 2.4.1 EU Regulations

The following EU Regulations are of relevance with respect to the Electronic Fee Collection (EFC):

- Council Regulation No. 1999/62/EC of 17 June 1999 on the charging of heavy goods vehicles for the use of certain infrastructure
- Directive 2004/52/EC of the European Parliament and of the Council of 29 April 2004 on the interoperability of electronic road toll systems in the Community (Text with EEA relevance)
- Directive 2006/38/EC of the European Parliament and of the Council of 17 May 2006 amending Directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructures.

### 2.4.2 Standardisation

#### ISO

The International Organization for Standardization ([www.iso.org](http://www.iso.org)) is the world's largest developer of standards. ISO is a network of national standards institutes from 147 countries working in partnership with international organisations; governments, industry, business and consumer representatives. ISO is the source of 13 700 International Standards for business, government and society, although its principal activity is the development of technical standards. ISO and its Technical Committee 204 develops ITS standards in collaboration with CEN (and its TC278). Main ISO standards regarding EFC are:

- ISO 14906:2004 - Road transport and traffic telematics — Electronic fee collection — Application interface definition for dedicated short-range communication
- ISO 14815:2005 - Road transport and traffic telematics — Automatic vehicle and equipment identification — System specifications
- ISO 17573:2003 - Road Transport and Traffic Telematics — Electronic Fee Collection (EFC) — Systems architecture for vehicle related transport services.

Currently an ISO standard regarding electronic fee collection (EFC) based on Global Navigation Satellite Systems and Cellular Network (GNSS/CN) is drafted (draft ISO 17575) but not yet released because of the many objections of different countries regarding the contents of the draft standard.

#### CEN

The mission of the European Committee for Standardization (Comité Européen de Normalisation, [www.cenorm.org](http://www.cenorm.org)) is to promote voluntary technical harmonisation in Europe in conjunction with worldwide bodies and its partners in Europe. CEN covers a wide area with the aim to diminish trade barriers, promote safety, allow interoperability of products, systems and services, and to promote common technical understanding. In Europe, CEN works in partnership with the European Committee for Electrotechnical Standardization (CENELEC) and the European Telecommunications Standards Institute (ETSI). The European ITS standardisation work is primarily carried out under CEN and its Technical Committee (TC) 278 on Road Transport and Traffic Telematics.

Main CEN standards regarding EFC are:

- EN 12253:2004 - Road transport and traffic telematics - Dedicated short-range communication - Physical layer using microwave at 5,8 GHz
- EN 12795:2003 - Road transport and traffic telematics - Dedicated Short Range Communication (DSRC) - DSRC data link layer: medium access and logical link control,
- EN 12834:2004 - Road transport and traffic telematics - Dedicated Short Range Communication (DSRC) - DSRC application layer
- prEN 15509:2006 - Road transport and traffic telematics — Electronic fee collection — Interoperability application profile for DSRC.

### **Others**

The European Telecommunications Standards Institute ETSI ([www.etsi.org](http://www.etsi.org)) is a non-profit organisation whose mission is to produce the telecommunications standards that will be used throughout Europe and beyond for decades to come. ETSI plays a major role in ITS standardisation, in particular in the development of telecommunications tests standards.

## 2.5 Additional information

### 2.5.1 WEB Links

WEB Links of government sites with information about EFC Schemes:

URL	Authority / Country	Comments
<a href="http://www.asfinag.at/index.php?idtopic=26">http://www.asfinag.at/index.php?idtopic=26</a>	Federal Road Authority Austria	In German, some parts in English
<a href="http://www.lsva.ch">http://www.lsva.ch</a>	Swiss Customs Administration Switzerland	In German, French, Italian
<a href="http://www.are.admin.ch/are/de/verkehr/lsva/index.html">http://www.are.admin.ch/are/de/verkehr/lsva/index.html</a>	Switzerland	
<a href="http://www.bag.bund.de">http://www.bag.bund.de</a>	Germany	In German
<a href="http://www.bmvbs.de/en">http://www.bmvbs.de/en</a>	Germany	
<a href="http://portal.wko.at/wk/format_detail.wk?AngID=1&amp;StID=240298&amp;DstID=1736&amp;BrID=45">http://portal.wko.at/wk/format_detail.wk?AngID=1&amp;StID=240298&amp;DstID=1736&amp;BrID=45</a>	Austrian federal economic chamber Austria	In German, overview of most European countries
<a href="http://www.mdcr.cz">http://www.mdcr.cz</a>	Ministry for Transport Czech Republic	Only some info in English
<a href="http://www.rsd.cz">http://www.rsd.cz</a>	Road Authority Czech Republic	

WEB Links of commercial WEB-sites with information about EFC Schemes:

URL	Organisation / Country	Remarks
<a href="http://www.toll-direct.de">http://www.toll-direct.de</a>	Germany	
<a href="http://www.premid.cz">http://www.premid.cz</a>	Czech Republic	
<a href="http://www.go-maut.at">http://www.go-maut.at</a>	Austria	In German
<a href="http://www.toll-collect.de">http://www.toll-collect.de</a>	Germany	
<a href="http://www.mautabelle.de">http://www.mautabelle.de</a>	Bundesanstalt für Strassenwesen (BAST) Germany	In German
<a href="http://www.maut.de">http://www.maut.de</a>	Germany	
<a href="http://www.truckinfo.ch">http://www.truckinfo.ch</a>	Switzerland	

WEB Links of software suppliers (sample only):

URL	Organisation / Country	Remarks
<a href="http://www.applilog.com/">http://www.applilog.com/</a>	Germany	
<a href="http://www.mautcontrol.de">http://www.mautcontrol.de</a>	Germany	In German
<a href="http://www.nufatron.ch/Pdf/TRD-LIB2000.pdf">http://www.nufatron.ch/Pdf/TRD-LIB2000.pdf</a>	Switzerland	In German
<a href="http://www.mt-tech.at/index.php?option=com_content&amp;task=view&amp;id=6&amp;Itemid=24">http://www.mt-tech.at/index.php?option=com_content&amp;task=view&amp;id=6&amp;Itemid=24</a>	Austria	In German

## 3 Digital Tachograph

### 3.1 Background

A tachograph is a combination of a clock and a speedometer and is fitted to commercial vehicles. Its task is the recording of the vehicle's speed and the period of time that the vehicle is moving for every individual driver. The recording of the driver's individual duty periods is mandatory in commercial vehicles in European countries for enforcement of working-time regulations; speed records are also used for accident reconstruction purposes.

#### 3.1.1 Origins and implementation of the analogue tachograph

Tachographs were originally introduced in 1835 for the railroads for a better documentation of irregularities. In 1923, the first tachograph (the so called "eddy current speedometer") was introduced by the German company Kienzle. It was able to record driving and rest time only. Distance recording was added two years later. Due to an increase in both traffic speed and the number of traffic accidents caused by heavy vehicles in the 1930s, tachographs became important for evidence of correct speed and sufficient rest times.

A leading role in the mandatory implementation of the tachograph was taken by Germany. In the early 1950s, the tachograph was made mandatory in Germany for all commercial vehicles. With the Verkehrs-Sicherungs-Gesetz (StVZO, Traffic Safety Law of December 19 1952), the tachograph was declared mandatory in Germany for all commercial vehicles weighing over 7.5 t. From 1953 onwards, all new commercial vehicles and buses in Germany had to be equipped with the device based on StVZO § 57a.

Regulation (EEC) No. 543/69 of 25 March 1969 was the first multinational regulation concerning driving and rest time of professional drivers. With Council Regulation (EEC) No. 3821/85 the tachograph was declared mandatory equipment in the European Economic Community (EEC); the regulation was effective from 29 September 1986.

However, there was a growing concern that the analogue tachograph was easy to cheat, in some cases resulting in fraudulent recording and monitoring of the driver's hours and the vehicle activities. The purpose of the digital tachograph was to end the possible abuses of the analogue system by introducing new recording equipment which digitally stored the relevant information on a personal driver card.



### 3.1.2 Road map of implementation of digital tachograph for EU countries

In September 1998 the council of the European Union adopted Regulation No. (EC) 2135/98, changing Council Regulation (EEC) No. 3821/85. This new regulation provided for the introduction of a new kind of tachograph, commonly known as the digital tachograph.

The EU’s main objectives for the new digital tachograph were to improve enforcement, to enhance fair competition, to increase road safety, and to maintain satisfactory social standards.

On 5 August 2002, annex 1B of the Commission Regulation No. 1360/2002 was released. This annex defines the vehicle device on a technical basis (technical specification) and is binding for all European Union (EU) and European Economic Area (EEA) countries. It was planned that 24 months after the publication, from the 5 August 2004, all newly registered vehicles had to be fitted with a digital tachograph.

Due to difficulties caused by the manufacturers who had to obtain type approval, and later the member states who had to make the necessary legal and practical arrangements, (for example issues of smart cards), the mandatory introduction date had to be postponed several times. The European Commission rescheduled the introduction date twice: first to 5 May 2005 and later to 1 January 2006.

On 15 March 2006, the European Council and the European Parliament finally adopted Regulation (EC) No. 561/2006 which repealed Council Regulation (EEC) No 3820/85. The new regulation was published on 11 April 2006, which led to a mandatory introduction of the digital tachograph on all newly registered trucks with a weight of more than 3.5 t and buses carrying more than nine persons by 1 May 2006.

As shown in Figure 16, it took almost eight years from the definition of the basic provision until the digital tachograph was finally introduced.

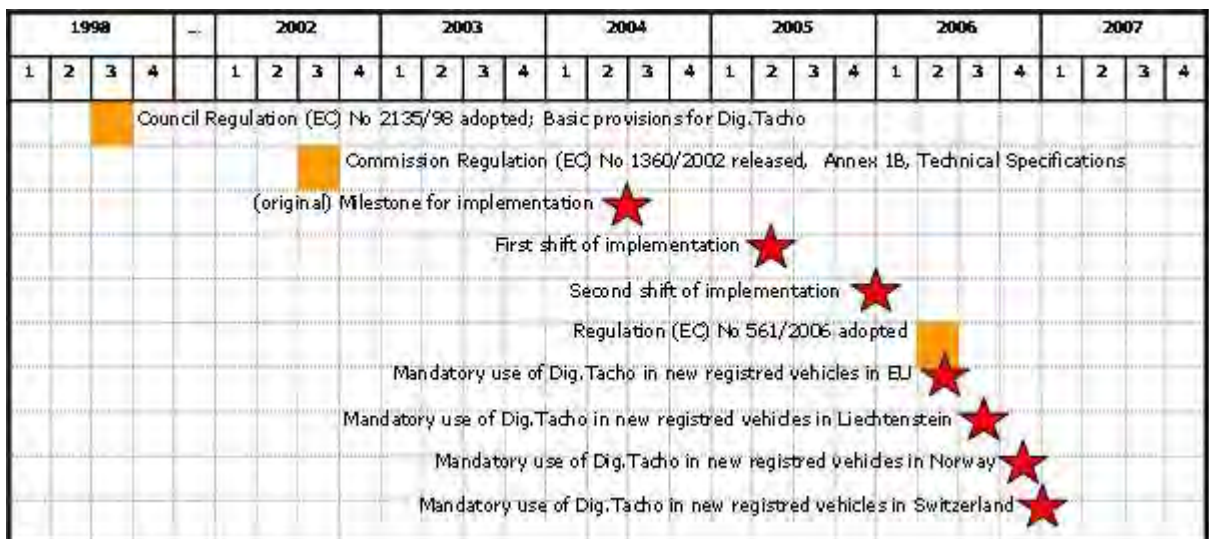


Figure 16: Road Map of implementation

**Example of national regulations**

National regulations may apply to the requirement to be equipped with a tachograph. In the UK, for example, special regulations apply for vehicles only carrying equipment and materials for the driver's own use and such vehicles are exempt from installing a tachograph. Figure 17 shows the complexity of the definition of liable vehicles in the UK:

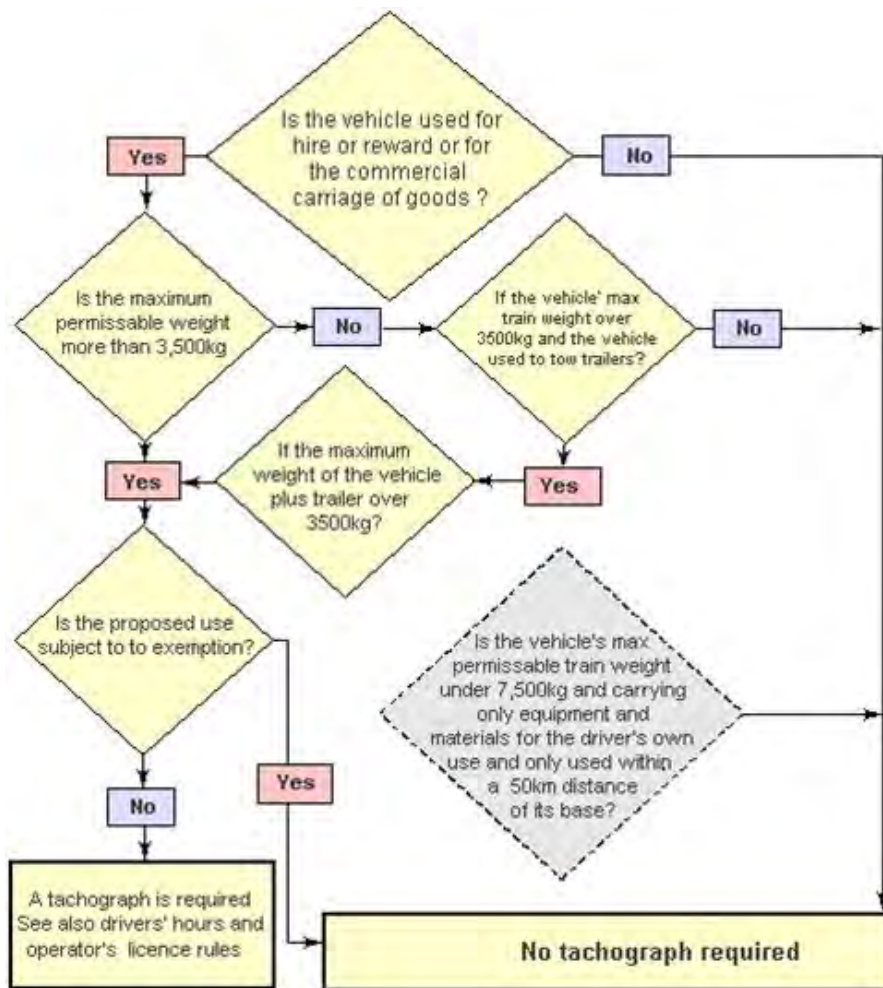


Figure 17: Vehicles liable to be equipped with Tachograph in UK

[[http://www.ntta.co.uk/images/Tachograph\\_chart\\_1.gif](http://www.ntta.co.uk/images/Tachograph_chart_1.gif)]

## 3.2 Tachograph

### 3.2.1 Basics about the Tachograph

Since 1986, tachographs have been mandatory equipment in Europe for vehicles with a Maximum Permissible Gross Laden Vehicle Weight (MGVW) over 3.5 t and for vehicles which are built to carry at least nine passengers and are being used for commercial purposes.

The tachograph is used to check the driving and rest times of drivers during reviews by the enforcement authorities or in case of accident investigation. A driver must carry the tachograph records with him for all days of the current week and the last day of the previous week that he drove. Companies must keep the tachograph records for one year. Detailed information about drivers' hours and tachograph rules for goods and road passenger vehicles in UK and Europe can be found in two booklets issued by UK VOSA<sup>1</sup> (United Kingdom Vehicle & Operator Services Agency).

A tachograph combines the functions of a clock and a speedometer. Fitted to a motor vehicle, a tachograph will record not only the vehicle's speed but also the length of time that it is moving or stationary. The mechanical analogue tachograph writes on a waxed paper disc which constantly turns throughout the working day (see Figure 18). The marker moves nearer to or further from the centre according to the driving speed. An entire rotation encompasses 24 hours. However, analogue tachographs are vulnerable to tampering and are being replaced by digital tachographs which record data on smart cards. The list price is approximately 900 AUD for an analogue tachograph and 1300 AUD for a digital tachograph.

The largest difference between analogue and digital tachographs (Figure 19) is the use of a smart card in a digital tachograph instead of the record sheets (often called charts, discs, tachos) used in analogue tachographs.



Figure 18: Disc of an Analogue Tachograph



Figure 19: Example of Digital Tachograph

<sup>1</sup> <http://www.vosa.gov.uk/vosacorp/whatsnew/whatsnew.htm>

### 3.2.2 Components of a Digital Tachograph

According to the new EU regulations, all new vehicles put into service since 1 May 2006 with a laden gross weight over 3.5 t or with a capacity for more than eight (with the driver nine) people have to be fitted with a digital tachograph. Older vehicles with an analogue tachograph do not have to (but can) be upgraded with a digital tachograph. Even if the analogue tachograph breaks down and can be repaired, it is not mandatory to upgrade it to a digital one. A retrofit of the entire HGV fleet was considered not feasible.

Figure 20 gives an overview of the main System Components of a Digital Tachograph.

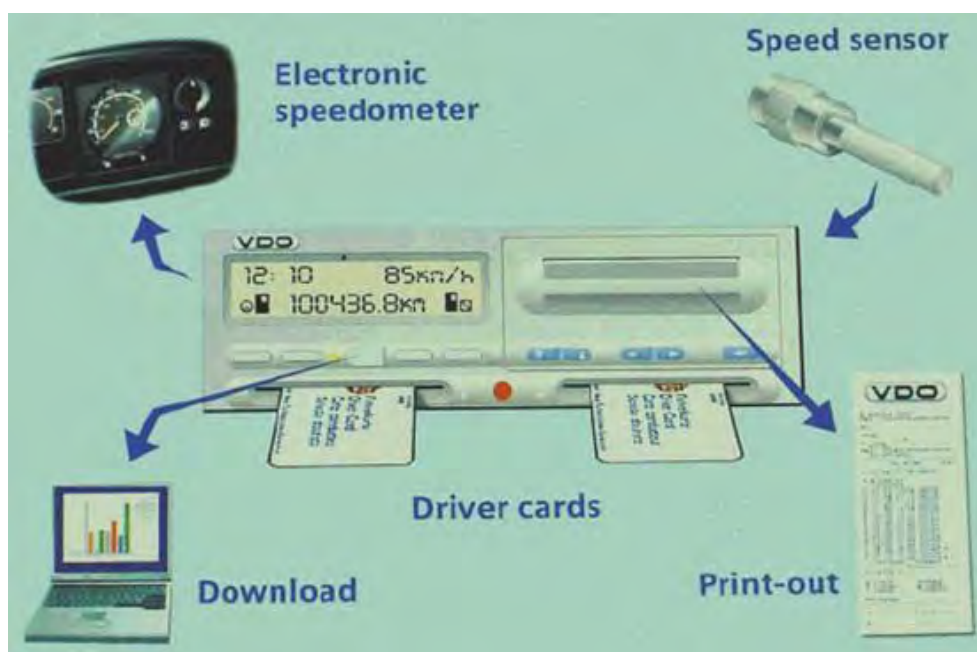


Figure 20: System Components of Digital Tachograph

[<http://www.transportoffice.gov.uk/crt/images/cont040238-1.gif>]

The digital tachograph is a radio-slot sized unit essentially containing:

- Two Smart Card readers
- integrated printer for producing reports for driver and enforcement officers
- display of all the key information, e.g. on current driving and rest times
- real-time clock
- control buttons.

The digital tachograph is connected to the gearbox by a secured sensor. The digital tachograph is the “brain” of the system and is able to hold in mass memory data on drivers and their periods of driving and duty for about a 12 month period. Among other things, it also holds data relating to faults, attempts to tamper or defraud the system, speeding, calibration details and when data has been accessed (for example by the enforcement authority). The time shown on the digital tachograph can be the local time, but all recordings have to be in Universal Time Coordinated (UTC), i.e. Greenwich Mean Time.



Installation and calibration of the devices are carried out by workshops accredited by the responsible ministry of each country. These workshops are also in charge of maintaining and routinely testing digital tachographs.

The system of the digital tachograph is controlled by four different Smart Cards: Driver, Company (operators), Workshop (Vehicle manufacturers or Tachograph Calibration Centres) and Control Card for enforcement authorities. Each Smart Card is issued according to the specific needs.

The Smart Cards enable the use of and/or give access to the data in the digital tachograph:

- Driver Card—used by drivers to allow the recording of drivers’ hours
- Company Card—for use by the operator to protect and download the data
- Workshop Card—available only to vehicle manufacturers and calibration centres
- Control Card—available for carrying out enforcement tasks (e.g. Police)

Regardless of which cards are inserted, recorded data in the mass memory of the digital tachograph cannot be deleted. With average use, the last 28 working days are stored on the Driver Card and the last 365 days are stored in the mass memory of the vehicle device. The mass memory operates a rolling system in which the latest data automatically overwrites the oldest stored data. Earlier data is lost if it has not been downloaded or backed up on another data storage media. More details about the Smart Card are given in the following chapter.

**Manufacturers**

Currently four companies are producing type approved digital tachographs for the European market (Figure 21):

Company	Brand
Actia France  WEB: <a href="http://www.actiaTachographs.com">http://www.actiaTachographs.com</a>	Brand: Smartach 
Delphi Grundig Germany  WEB: <a href="http://www.delphigrundig.com/">http://www.delphigrundig.com/</a>	Brand: Delphi Grundig Digital Tachograph 

Company	Brand
<p>SiemensVDO Germany</p> <p>WEB: <a href="http://www.siemensvdo.com/dtco">http://www.siemensvdo.com/dtco</a></p>	<p>Brand: DTCO 1381</p> 
<p>Stoneridge United Kingdom</p> <p>WEB: <a href="http://www.stoneridgeelectronics.co.uk">http://www.stoneridgeelectronics.co.uk</a></p>	<p>Brand: SE5000</p> 

Figure 21: Overview Digital Tachograph and Manufacturers

The price for a digital tachograph, which is normally pre-installed in the truck, is around 1300 AUD, whereas the price for an analogue tachograph was around 900 AUD. A separate installation or retro-fit of a digital tachograph requires working time of approximately three to four hours. In Switzerland this would cost about 400 – 500 AUD, in other European countries about 300 – 400 AUD.

In addition, there are also several software tools available for transport operators to store and use the data recorded by the digital tachograph (see WEB Links section). The recorded data can also be used for fleet management and fleet maintenance purposes.

### 3.2.3 Digital Tachograph Stakeholders

The digital tachograph system relies on several stakeholders, as depicted in Figure 22 and described in Table 3.

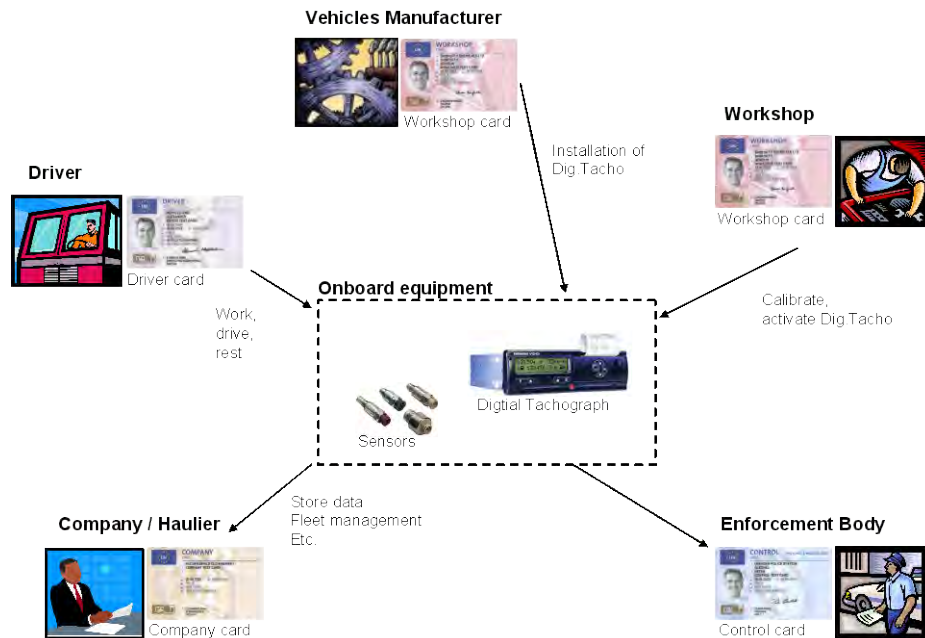


Figure 22: Stakeholders and Infrastructure





Table 3: Digital Tachograph Stakeholders

Stakeholder	Function / Responsibility
Vehicle Manufacturer	The vehicle manufacturer installs the sensors and the Digital Tachograph and activates the Digital Tachograph. To activate the Digital Tachograph, the manufacturer's workshop card is necessary. The recording of the vehicle movements by the Digital Tachograph starts.
Workshop	The Digital Tachograph has to be calibrated by the workshop. Parameters and data such as tyre diameter, licence-plate number, etc. are entered. For this work, a workshop card is necessary. Each employee of the workshop has his own card with a personal PIN-code. After the first calibration with a workshop card, the encoded communication between the sensors and the Digital Tachograph is activated. From now on, all manipulation attempts will be registered and logged with date and time.
Company / Haulier	The vehicle will be handed over to the owner of the vehicle. The Haulier inserts its company card for the first time and from now on the mass memory on the Digital Tachograph is locked for his company. The access to the data on the Digital Tachograph is not possible with any other company card. With the correct company card, the data can be downloaded at any time (as long as it is not overwritten with newer data).
Driver	Now the vehicle is ready for the driver. Before he starts his journey, the driver has to insert the driver card in slot 1 of the Digital Tachograph which activates the power supply. If a second driver is on-board, he inserts his Card in slot 2. The rest times, loading and unloading activities are entered manually. The Card is removed only at the end of work.
Enforcement body	During an enforcement check, the driver card stays in slot 1 and the enforcement officer inserts the control card in slot 2 of the Digital Tachograph. The enforcement officer can now download, print or just have a look at the recorded data on the Driver Card and the Digital Tachograph.

### 3.2.4 Digital Tachograph Smart Cards

The system of the Digital Tachograph is controlled by four different smart Cards, as depicted in Table 4.

**Table 4: Overview Digital Tachograph Smart Cards**

	Driver Card	Company Card	Workshop Card	Control Card
				
User	Driver Each driver must only have one valid Driver Card.	Companies A company may hold several company Cards.	Approved Workshops Vehicle manufacturers	Enforcement body (e.g. Police) Can be issued to enforcement officers or authorities
Function	Saves an average of 28 days of driver's activities.	Protects the sensitive data from access by unauthorised people Contains a maximum of 230 records related to locking and downloading performed.	Used to activate, calibrate and download Tachograph Can store at least 88 records of calibration and/or time adjustment. Is used for test drives.	Enables to read, print or download the data saved on the Driver Card or in the mass storage of the vehicle unit. Can store 230 records of control activity data.
Stored data on the Card	Card identification Card holder identification Driving licence information Vehicle-used Driver activity data, such as: <ul style="list-style-type: none"> <li>Data entered manually by the driver</li> <li>Daily presence counter</li> <li>Date and total distance travelled by the driver on this date</li> <li>Driver status at 00:00</li> <li>The driving status (crew / single)</li> <li>The slot used (driver / co-driver)</li> <li>The card status (inserted / not)</li> <li>The activity (driving, availability, work, break/rest)</li> <li>The time of each change of activity</li> <li>The time of each change in driving status</li> <li>Work location</li> </ul> Event data, such as: <ul style="list-style-type: none"> <li>Time overlap</li> <li>Card insertion while driving</li> <li>Power supply interruption</li> <li>And more</li> </ul> Faults data Control activity data	Card identification Card holder identification Company / haulier activity data such as: <ul style="list-style-type: none"> <li>Time and date of the activity</li> <li>Type of activity</li> <li>Period downloaded (if any)</li> </ul>	Card identification Card holder identification Vehicle used data Driver activity data Locations Events and faults data Control activity data Calibration and time adjustment data <ul style="list-style-type: none"> <li>Purpose of calibration</li> <li>Vehicle identification</li> <li>Parameters updated or confirmed</li> <li>Recording equipment identification (Digital Tachograph serial number)</li> <li>Specific conditions data</li> </ul>	Card identification Card holder identification Control activity data such as: <ul style="list-style-type: none"> <li>Time and date of the control</li> <li>Type of control</li> <li>Period downloaded (if any)</li> </ul>



	Driver Card	Company Card	Workshop Card	Control Card
<b>Costs to apply a card</b>	Vary in every county, e.g.: UK: AUD 95 CH: AUD 95 (range AUD 52-115)	Vary in every county, e.g.: UK: AUD 95 CH: AUD 95 (range AUD 49-140)	Vary in every county, e.g.: UK: Free of charge CH: AUD 101 (range: AUD free -159)	Vary in every country, e.g.: UK: Free of charge CH: AUD 66 (range AUD free - 115)
<b>Validity</b>	The Driver Card validity is decided by Member States. However it cannot exceed 5 years.	Has no administrative expiry specified in the Regulation, but Member States can introduce an expiry date	One year	Has no administrative expiry specified in the Regulation
<b>Replacement/ Renewal/ Exchange</b>	A lost card must be reported within 7 (calendar) days. It loses its validity.  Changes (e.g. change of name, address) will result in an exchange of the Card.	A lost Card must be reported within 7 (calendar) days. It loses its validity.	A lost Card must be reported within 7 (calendar) days. It loses its validity.  Renewal due to expiry: The workshop has to prove that the worker is still approved.	-
<b>Renewal</b>	Max. 6 months in advance, Min 15 days before expiry	Example CH: same as Driver Card	Max. one month in advance, min. 15 day before expiry, in Switzerland same as Driver Card	-
<b>Documents needed for application of the smart cards</b>	Minimum a driving licence category B (credit Card format) or a learner's licence category B  Residence in the issuing country Certificate of birth name, surname, forename, date and place of birth  Picture (in front of a bright background, same as in the driving licence)	Name, address, place of business (must be in the issuing country) of the company  Registration of business (for the first Card)  Birth name, surname, forename, date and place of birth, address of the businessman or (if legal person) of the responsible person within the company  Has to be signed by the businessman himself or by a authorised person	Name, address, place of business (must be in the issuing country)  Registration of business (for the first Card)  Certificate of approval of the workshop / manufacturer  Certificate of competence of each mechanist applying for a workshop Card	-
<b>Additional Remarks</b>	The Driver Card has to be handed over to the company upon request (at the latest after 28 working days) for downloading / copying the data.  After expiry the Card has to be onboard for at least 7 days.  If the Card is broken, lost or stolen, driving without a Driver Card is allowed for maximum 15 days.  Prints have to be made during that period.	Maximum 62 company Cards can be issued on the same company identification number  If more Cards are needed a second company identification number has to be requested.	Each mechanic has a personal PIN-code	

### 3.2.5 Additional services

Tachograph data are accessible to the users such that they can be used to create additional services. A download tool is needed for the transfer of data saved on the mass memory of the digital tachograph and on the driver card. Software solutions for the subsequent data management are offered on the market, including web based programmes. However, most manufacturers offer a tool for downloading the data and a software solution as a package.

The various functions of such software are:

- archiving the data of the mass memory of the digital tachograph and the driver card
- speed profiles
- activities of the driver
- graphical analysis
- data export
- comparison with social regulations
- overview of offences.

The data recorded by the digital tachograph can also be used by the companies for their fleet management.

The prices for such tools and software vary from several hundred to several thousand AUD.

### 3.2.6 Impact and effects

#### 3.2.6.1 Reasons of introduction

The EU intends to take advantage of newly available technology in order to ensure the security of the recording of the driver's duty periods. The aim is that the new system is less vulnerable to illegal acts by users to distort the data. The new system will also allow easier and better control of driver hours by operators and the enforcement authorities. This will ensure that the original objectives of the digital tachograph are met:

- road safety
- increased security against manipulation of the digital tachograph
- social legislation
- providing a technological platform for operators which is supported in a stable environment.

#### 3.2.6.2 Functions and improvements

The analogue and old mechanical tachographs were rather easy to manipulate. Today's general requirements regarding function and safety for such recording are, therefore, no longer satisfied.

With the new digital tachograph, the authorities and hauliers get a useful and simple tool to check compliance with legislation. The digital records of driving, working and rest time can also be used for fleet management or wage accounting. In addition, the drivers get an advance warning of a possible violation of certain regulations.

Main changes from analogue to digital:

- more precise recording of working, driving and rest times of professional drivers
- more precise recording of speed and distance
- just one personal driver card instead of one anonymous tachograph disc per day
- easy processing of the digital data through the company
- easy and fast control possibilities through the enforcement bodies with the control card
- reduction of the possibility of manipulation (security mechanism).

#### 3.2.6.3 Observed short time impacts

The introduction of the digital tachograph had some short term impacts on the heavy goods vehicle market and vehicles' registration activities. According to statistics prepared by the European Automobile Manufacturers Association, the following facts could be observed in the spring of 2006:

- April 2006: truck registrations soared by 75.4% in anticipation of digital tachographs becoming mandatory from 1 May 2006
- In May 2006, the truck market remained distorted due to the implementation of digital tachograph rules.

### 3.3 Regulatory documents

#### 3.3.1 EU Regulations

The following EU Regulations are of relevance with respect to the (digital) tachograph resp. driving and rest times for drivers:

- Council Regulation (EEC) No 3820/85 of 20 December 1985 on the harmonisation of certain social legislation relating to road transport
- Council Regulation (EEC) No 3821/85 of 20 December 1985 on recording equipment in road transport
- Council Directive 88/599/EEC of 23 November 1988 on standard checking procedures for the implementation of Council Regulations (EEC) No 3820/85 and (EEC) No 3821/85
- Council Regulation (EC) No 2135/98 of 24 September 1998 on recording equipment in road transport amending Council Regulation (EEC) No 3821/85 and Directive 88/599/EEC
- Commission Regulation (EC) No 1360/2002 of 13 June 2002 on recording equipment in road transport amending Council Regulation (EEC) 3821/85 - and its technical Annex 1B were published in the Official Journal of the European Communities (the OJ) on 5 August 2002.
- Regulation (EC) No 561/2006 of the European Parliament and of the Council of 15 March 2006 on the harmonisation of certain social legislation relating to road transport and amending Council Regulations (EEC) No 3821/85 and (EC) No 2135/98 and repealing Council Regulation (EEC) No 3820/85.

Figure 23 is a visual overview of all the relevant legislation and the way it interrelates, starting with social regulations affecting the transport sector through special tachograph legislation to the technical specification itself and the specific national requirements.

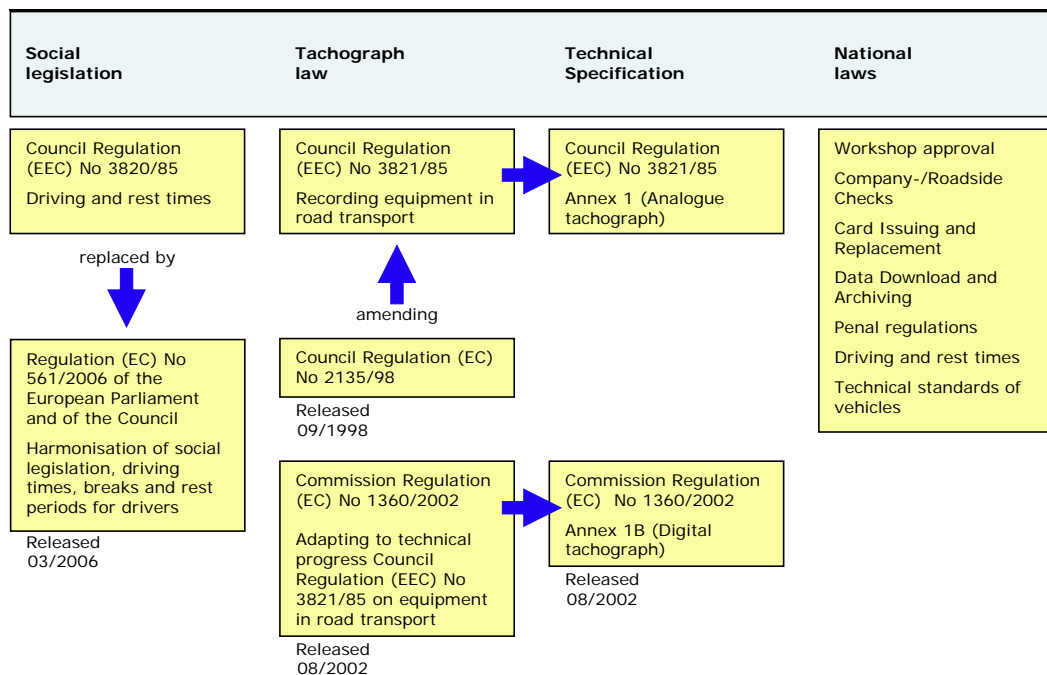


Figure 23: EU legislation

### On-going developments

To improve the compliance with the rules, the European Commission adopted a proposal COM (2003)628 by which it intends to update and amplify Directive 88/599/EC.

The proposal has three aims:

- to increase the number of checks carried out both at the roadside and on the premises of undertakings;
- to improve the quality of enforcement by ensuring enforcement staff are well trained and equipped, that Member State enforcement agencies co-operate at national and international level; and
- that a common approach be developed towards the issue of offences and sanctions, by Member States recognising that certain offences should be considered serious and hence attract appropriate sanctions, and indeed that Member States should make use of the full range of sanctions available.

[[http://ec.europa.eu/transport/road/policy/socialprovision/enforcement/index\\_en.htm](http://ec.europa.eu/transport/road/policy/socialprovision/enforcement/index_en.htm)]

### 3.3.2 National Regulations

Based on the mentioned EU Regulations, all member states have to ensure the availability and provide all necessary infrastructure and equipment for application, personalisation and issuing of digital tachograph Smart Cards all over the country.

As an example, the following (adaptation of) national regulations have been released in Austria:

- Adaptation of the national regulation about driving and rest times for drivers: (change of: Kraftfahrgesetz 1967 (25. KFG-Novelle), die 3. Kraftfahrgesetz-Novelle, das Arbeitszeitgesetz und das Arbeitsruhegesetz).

and

- Edict about digital tachograph Smart Cards (Verordnung des Bundesministers für Verkehr, Innovation und Technologie, mit der Bestimmungen über die Erlangung von Kontrollgerätekarten festgelegt werden (Kontrollgerätekartenverordnung - KonGeV)).

### 3.4 Additional information

#### 3.4.1 WEB Links

WEB Links of governmental sites with information about digital tachographs:

URL	Authority / Country	Remarks
<a href="http://www.eu-digitalTachograph.org/">http://www.eu-digitalTachograph.org/</a>	Supported by EU Commission and Swedish Road.Admin. Monitoring of the Implementation of the Digital Tachograph (MIDT)	In English
<a href="http://www.transportoffice.gov.uk/crt/lorryandvanoperators/drivershoursandTachographs/digitalTachographinformationforoperators/digitalTachographinformationforoperators.htm">http://www.transportoffice.gov.uk/crt/lorryandvanoperators/drivershoursandTachographs/digitalTachographinformationforoperators/digitalTachographinformationforoperators.htm</a>	UK	In English
<a href="http://www.transport.ie/roads/RoadHaulage/InternationalSection/digitalTachograph.asp?lang=ENG&amp;loc=1574">http://www.transport.ie/roads/RoadHaulage/InternationalSection/digitalTachograph.asp?lang=ENG&amp;loc=1574</a>	Ireland	In English
<a href="http://www.bag.bund.de/cIn_002/nn_45960/DE/VerkehrsThemen/Strassenkontrolldienst/DigitalesKontrollgeraet/digitaleskontrollgeraet.html">http://www.bag.bund.de/cIn_002/nn_45960/DE/VerkehrsThemen/Strassenkontrolldienst/DigitalesKontrollgeraet/digitaleskontrollgeraet.html</a>	Germany	In German only
<a href="http://www.asfinag.at/index.php?idtopic=240">http://www.asfinag.at/index.php?idtopic=240</a>	Austria	In German only
<a href="http://www.dfs.astra.admin.ch/">http://www.dfs.astra.admin.ch/</a>	Federal Road Authority, Switzerland	In German and French

WEB Links of commercial WEB-sites with information about digital tachographs:

URL	Organisation / Country	Remarks
<a href="http://www.ntta.co.uk">http://www.ntta.co.uk</a>	National Trailer and Towing Association (NTTA), UK	English
<a href="http://www.digitaler-tachograph.com">http://www.digitaler-tachograph.com</a>	WEB-site of "Verkehrsrundschau", an on-line news portal about traffic and transport related information.	In German only
<a href="http://www.digital-tachograph.com">http://www.digital-tachograph.com</a>	Tachograph Analysis Consultants Limited Commercial information and service supplier.	English
<a href="http://www.digitalertachograph.at">http://www.digitalertachograph.at</a>	Commercial information and service supplier, specialised in on-line archiving of digital tachograph data.	In German only

WEB Links to the manufacturers of digital tachographs:

URL	Company / Country	Remarks
<a href="http://www.actia.fr">http://www.actia.fr</a> <a href="http://www.actiaTachographs.com">http://www.actiaTachographs.com</a>	Smartach	In English
<a href="http://www.delphigrundig.com/">http://www.delphigrundig.com/</a>	Delphi Grundig Germany	In several languages
<a href="http://www.siemensvdo.com/dtco">http://www.siemensvdo.com/dtco</a>	DTCO 1381	In several languages
<a href="http://www.stoneridgeelectronics.co.uk">http://www.stoneridgeelectronics.co.uk</a>	SE5000 Digital Tachograph	In English

WEB Links of stakeholders:

URL	Organisation / Country	Remarks
<a href="http://www.iru.org">http://www.iru.org</a>	International Road Transport Union, Geneva, Switzerland	In English
<a href="http://www.acea.be">http://www.acea.be</a>	European Automobile Manufacturers Association, Brussels, Belgium	In English
<a href="http://www.ertico.com">http://www.ertico.com</a>	<a href="#">Intelligent Transport Systems - Europe (ERTICO), Brussels, Belgium</a> ITS Europe is a multi-sector, public/private partnership pursuing the development and deployment of Intelligent Transport Systems and Services (ITS).	In English
<a href="http://www.erf.be/section">http://www.erf.be/section</a>	European Union Road Federation (ERF), Brussels, Belgium	In English

WEB Links of software suppliers (sample only):

URL	Product / service offered	Remarks
<a href="http://tnn.rtd.co.uk/">http://tnn.rtd.co.uk/</a>	Archiving and analysis of tachograph data	In English
<a href="http://www.zamik.de">http://www.zamik.de</a>	Analysis of analogue and digital tachograph data Check with EC social legislation	In German only
<a href="http://www.tachoplus.com">http://www.tachoplus.com</a>	<a href="#">Network solution of archiving and analysis of digital tachograph data</a>	<a href="#">In German only</a>
<a href="http://www.ByteBar.eu">http://www.ByteBar.eu</a>	WEB based internet service with main focus on responsibilities of the company to abide by regulations of driving and rest time	In German only
<a href="http://www.tachografen.de">http://www.tachografen.de</a>	Manufacturer of the Dako-download-key and software for the analysis of analogue and digital tachograph data with social legislation module Modular construction	In German only
<a href="http://www.xmatik.ch">http://www.xmatik.ch</a>	Archiving and analysis of digital tachograph data	In German only

### 3.4.2 Facts and figures about Digital Tachographs

The following table details all the relevant facts and figures about the implementation in Europe by country.

Facts and Figures about Digital Tachograph in Europe											
Nr.	Country	Date of implementation	Driver cards issued	Company cards issued	Workshop cards issued	Control cards issued	Total cards issued	Number of approved workshops	Number of trained control officers	First issue date for cards	Status
1	Austria	01. May 2006	10'525	1'844	405	550	13'324	175	2'700	n/a	May.2005
2	Belgium	01. May 2006	30'880	4'886	924	3'099	39'789	184	n/a	n/a	26.Oct.2006
3	Bulgaria	01. January 2007	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
4	Cyprus	01. May 2006	n/a	n/a	n/a	n/a	n/a	2	15	n/a	31.Jan.2007
5	Czech Republic	01. May 2006	n/a	n/a	n/a	n/a	1'850	25	large number??	n/a	n/a
6	Denmark	01. May 2006	15'711	2'696	692	611	19'710	150	300	n/a	Nov.2006
7	Estonia	01. May 2006	2'050	169	38	13	2'270	15	13	n/a	25.Sep.2006
8	Finland	01. May 2006	7'727	1'398	201	401	9'727	140	500	n/a	n/a
9	France	01. May 2006	190'225	24'688	1'330	2'132	218'375	475	2'000	n/a	10.Nov.2005
10	Germany	01. May 2006	309'425	45'232	7'204	9'908	371'769	2'295	n/a	n/a	10.Nov.2006
11	Greece	01. May 2006	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	31.Jan.2007
12	Hungary	01. May 2006	3'556	628	164	4	4'352	67	150	n/a	n/a
13	Ireland	01. May 2006	3'653	492	93	237	4'475	42	n/a	Feb.2006	n/a
14	Italy	01. May 2006	40'601	9'366	404	2'580	52'951	133	1'000	05.Aug.2005	n/a
15	Latvia	01. May 2006	2'372	402	27	10	2'811	6	9	n/a	31.Oct.2006
16	Lithuania	01. May 2006	5'790	561	19	162	6'532	16	39	n/a	01.Jan.2007
17	Luxembourg	01. May 2006	2'520	328	37	50	2'935	7	98	n/a	Nov.2006
18	Malta	01. May 2006	2	2	0	2	6	0	6	n/a	04.Dec.2006
19	Netherlands	01. May 2006	38'662	5'164	1'099	165	45'090	185	n/a	n/a	01.Oct.2006
20	Poland	01. May 2006	23'133	2'699	84	409	26'325	39	650		13.Nov.2006
21	Portugal	01. May 2006	88	11	10	0	109	10	0	early Jun.2006	08.Sep.2006
22	Romania	01. January 2007	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	31.Jan.2007
23	Slovak Republic	01. May 2006	8'358	803	34	35	9'230	10	59	n/a	27.Nov.2006
24	Slovenia	01. May 2006	2'788	416	45	22	3'271	20	205	28.Apr.2006	n/a
25	Spain	01. May 2006	101'788	30'930	784	7'533	141'035	630	400	n/a	01.Nov.2006
26	Sweden	01. May 2006	21'710	2'095	634	219	24'658	164	n/a	n/a	n/a
27	United Kingdom	01. May 2006	148'697	22'173	1'343	1'720	173'933	354	250	n/a	n/a
28	Iceland	n/a	97	10	6	10	123	n/a	10	21.Sep.2006	n/a
29	Liechtenstein	26. Ocotober 2006	19	1	11	9	40	4	2	01.Aug.2006	n/a
30	Norway	09. December 2006	14'287	2'236	345	227	17'095	125	200	01.Sep.2005	n/a
31	Switzerland	01. January 2007	1'804	233	403	637	3'077	270	180	18.Oct.2006 or 01.Nov.2006	16.Nov.2006
	<b>Total</b>		<b>986'468</b>	<b>159'463</b>	<b>16'336</b>	<b>30'745</b>	<b>1'194'862</b>	<b>5'543</b>	<b>8'786</b>		



### 3.4.3 Overview of AETR Countries

Member States of the European Agreement concerning the Work of Crews of Vehicles Engaged in International Road Transport (AETR) are:

- Andorra, Armenia (since 6 December 2006), Austria, Azerbaijan
- Belarus, Belgium, Bosnia and Herzegovina, Bulgaria
- Croatia, Cyprus, Czech Republic
- Denmark
- Estonia
- Finland, France
- Germany, Greece
- Holland, Hungary
- Ireland, Italia
- Kazakhstan
- Latvia, Liechtenstein, Lithuania, Luxemburg
- Macedonia, Malta, Moldova
- Norway
- Poland, Portugal
- Romania, Russia
- Serbia and Montenegro, Slovakia, Slovenia, Spain, Sweden, Switzerland
- Turkey, Turkmenistan
- United Kingdom, Uzbekistan.

Vehicles of all these countries are equipped with tachographs. Some countries accepted the AETR with reservations.

## 4 e-call / Emergency Call

### 4.1 Background

#### 4.1.1 History and reasons of e-Call

E-Call is one of the key elements of the eSafety Initiative of the European Commission. E-Call promotes a harmonised, pan European, in-vehicle emergency call service that builds on a location-enhanced single European Emergency Number (E112). The e-Call system comprises the following elements: a single European emergency number (112) with multi-language support, automatic location transmission calls (E112), plus manual and automatic triggers. The European Commission specifically encourages relevant standardisation as part of the process for the establishment of data requirements and transfer protocols, interface specification, routing and handling procedures.

E-Call technology has existed for about ten years. However, standards are required for the system to be interoperable throughout the EU. A Memorandum of Understanding (MoU) on arrangements for implementing the plan, which sets out measures to be taken by the European Commission, Member States and the automotive, telecom and insurance industries, now has over 50 signatures (status 15 December 2006) from industry, the European Commission and the Member States.

The key aim of the MoU is to ensure that e-Call technology will work in any EU Member State as well as in other European states (Iceland, Norway and Switzerland).

The situation for drivers is critical. At present, more than 40,000 people are killed and 1.8 million injured in about 1.4 million annual traffic accidents on EU roads. Those involved are often not able to call from their mobile phones and often do not know their position, especially on interurban routes and when abroad. The situation for those travelling abroad is even worse: most do not know which number to call in an emergency (in some countries over 60%) and language problems prohibit proper communication.

The economic loss caused by these crashes amounts to more than €160 billion (AUD 267 billion) per year.

#### 4.1.2 Road map of implementation of e-Call in Europe

The original action plan of e-Call aimed for an agreement on e-Call standardisation and specifications to be made by the end of 2005. By 2006, full scale field tests had been foreseen, with 2009 as the year for introducing e-Call technology in all new vehicles (truck, cars and buses).

To enable e-Call technology to work, emergency services in the EU Member States would need to equip or upgrade their Public Service Answering Points (PSAP) to process e-Call location reports by 2007 at the latest.

The participants of the High-Level Meeting on e-Safety held in Brussels on 3 February 2005 supported the recommendations and the action plan produced by the e-Call Driving Group, with the following main milestones for the e-Call roll-out:

- all key stakeholders to sign the MoU to ensure progress by end of 2006
- full specification of the e-Call system and start of development by mid-2007
- full-scale field tests to be performed from the beginning of 2008

- all key Member States ready with upgrade of PSAPs September 2009
- introduction of e-Call as standard option in all type-approved vehicles from 1 September 2010.

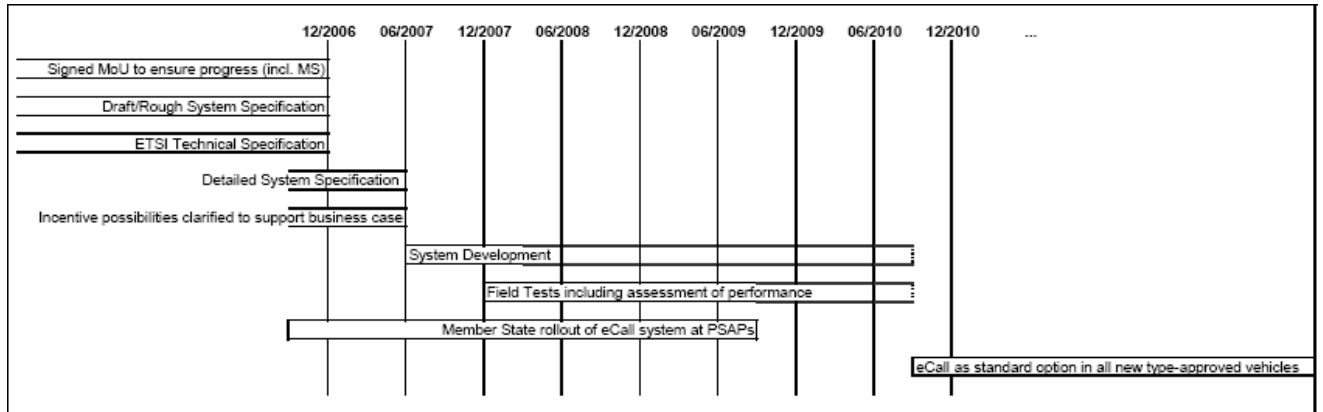


Figure 24: Revised road map of implementation

[Source: [http://www.esafetysupport.org/download/ecall\\_toolbox/Reports/Position\\_papers\\_DG\\_eCall\\_v2.pdf](http://www.esafetysupport.org/download/ecall_toolbox/Reports/Position_papers_DG_eCall_v2.pdf)]

On 27 April 2006, the European Parliament adopted, by a large majority, the report by British Member of the European Parliament Gary Titley on the introduction of e-Call as a public service. The report recommends that all European authorities include information about the in-vehicle emergency call within their public road safety campaigns and points out that “the large-scale roll-out of e-Call by 2009 is a priority of the eSafety initiative”. Presenting e-Call to the Parliament, European Commissioner for Information Society and Media, Viviane Reding, reiterated the importance of full community support and commitment from all stakeholders if the target to install e-Call in all new vehicles by 2009 is to be achieved.

The European Commission has proposed an urgent set of actions to restart moves to roll out the in-vehicle emergency e-Call in Europe. The Commission industry action plan agreed in 2005 to add e-Call to all new cars in Europe by 2009 has stalled, warns the Commission status report of 23 November 2006. Whilst there has been significant progress at a European level, some Member States have been slow to invest in infrastructure, and industry now refuses to take further action.

The initial 2005 Commission-industry agreement contained a framework for rolling out e-Call in Europe, targeting Member States which had to invest in emergency rescue service infrastructure. The Commission also agreed to monitor progress closely, and to take further action if e-Call deployment was endangered. As e-Call is based on the single European emergency number 112 and its location enhancement, E112, their implementation was also monitored. This led to serious concerns. Whilst the Commission has taken several measures supporting e-Call deployment and standardisation, and some Member States have already started e-Call deployment, many are not on track with the necessary infrastructure. Industry has already reacted with a new deployment timetable of 2010 instead of 2009.

The Commission's response is the communication adopted on 23 November 2006, *Bringing eCall back on track – Action Plan*. It presents two actions that are crucial for making e-Call a reality:

- Member States have been given clear actions with deadlines for solving the remaining legal, technical and socio-economic issues and proceeding with the necessary 112, E112 and e-Call infrastructures.
- Industry is asked to renew its commitment to e-Call. The Commission will also start negotiations with the associations of the automotive industry for a voluntary agreement for introducing e-Call devices into vehicles.

The development of the standardisation requirements that will enable the transmission of such in-vehicle voice and data to the PSAP will be the responsibility of the 3<sup>rd</sup> Generation Partnership Project (3GPP), a collaborative effort between Europe, Japan, China, North America and South Korea, aimed at defining a globally applicable third generation (3G) mobile phone system specification. ETSI\_MSG will provide recommendations on the path that 3GPP should follow.

Debating whether or not SIM cards should be required for e-Calls, (former) ERTICO Project and Development Manager Rasmus Lindholm pointed out that the e-Call Driving Group had not put forth a firm requirement for the PSAP to be able to call back the vehicle, eliminating one justification for SIM card use. The ability to identify the calling number has been another argument used to justify their need. However, as the minimum set of data transmitted to the PSAP includes the vehicle identification number — an alternative and equally good means of identification — this argument has been weakened. A report assessing the pros and cons of requiring SIM cards for e-Calls will be published shortly by a group of network operators.

Discussing the timeline for work on the e-Call standard, there was an agreement that March 2007 should be the target date for completion.

#### 4.1.3 Status February 2007

As shown, the original roadmap was too ambitious and even the revised road map had to be adapted again (Figure 24). As of February 2007, only seven EU member states (plus Iceland, Norway and Switzerland) had signed the MoU. For an implementation of e-Call, all EU member states have to sign the MoU. It is now expected that by mid 2007 15 member states will have signed the MoU. The target for the end of 2007 is 20 member states (Figure 25 & Table 5).

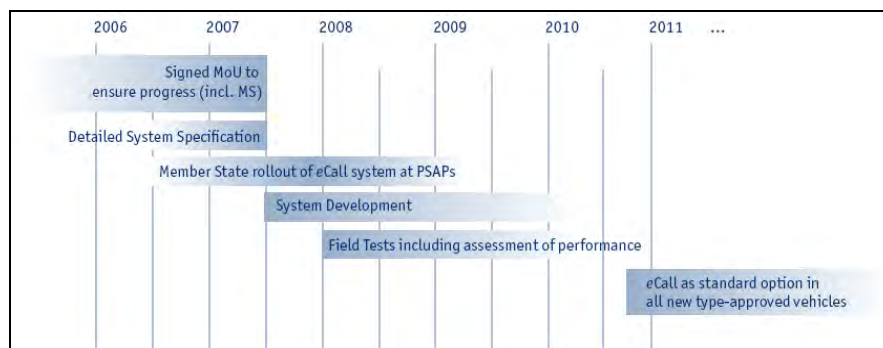


Figure 25: Newest road map of implementation, released on 22 February 2007  
[[http://www.ertico.com/download/publications/eCall\\_broch\\_070131-final.pdf](http://www.ertico.com/download/publications/eCall_broch_070131-final.pdf)]

**Table 5: Status of implementation of E112 and e-Call in Europe**

Member state	e-Call MoU signature (status December 2006)	Implementation Status (October 2006)	
		E112	e-Call
Austria	Procedure started	E112 introduced	eCall Pilot 2006
Belgium	Discussion between ministries	E112 introduced, upgrading and reorganisation of emergency centres	No progress reported
Bulgaria	No progress reported	No progress reported	No progress reported
Cyprus	Signed	E112 operational	No progress reported
Czech Republic	Procedure started	E112 operational	Trials planned Candidate for pilot
Denmark	Procedure started	E112 operational	Trials planned
Estonia	No progress reported	E112 introduced	No progress reported
Finland	Signed	E112 operational	Testbed operational Trials planned
France	Discussion between ministries	E112 introduced in some areas. France has some internal problems due to the several overlapping organisations working on emergency care at regional / local level	Starting a study
Germany	Support to e-Call. Länder delegated into Federal Ministry. Signature conditioned to solve data privacy and subsidiarity issues	E112 introduced	Trials planned
Greece	Signed	Planned for 2006	No progress reported
Hungary	Procedure started	Studying upgrading emergency centres	Candidate for pilot
Ireland	Discussion between ministries	E112 introduced	Has started studying the e-Call implementation
Italy	Signed	Upgrading emergency services	Trials planned Candidate for pilot
Latvia	No progress reported	E112 upgrading planned for 2007	No progress reported
Lithuania	Signed	Upgrading emergency centres	No progress reported
Luxembourg	No progress reported	E112 introduced	No progress reported
Malta	Discussions between ministries	E112 operational	Starting e-Call socio-economic study considering Malta specificity
Poland	No progress reported	Not available	No progress reported
Portugal	Discussions between ministries	E112 only for fixed lines	No progress reported
Romania	No progress reported		No progress reported
Slovakia	No progress reported	E112 operational	No progress reported
Slovenia	Signed	E112 operational	No progress reported
Spain	Regional competence	E112 operational in some regions	Position paper critical with e-Call
Sweden	Signed	E112 operational	Trials planned Candidate for pilot
The Netherlands	Procedure started	Upgrading PSAP	E-Call requirements foreseen in the upgrading. Candidate for pilot
UK	Subject to financial perspectives	E112 operational	E-Call research on UK PSAPs

Member state	e-Call MoU signature (status December 2006)	Implementation Status (October 2006)	
		E112	e-Call
Non EU Member states			
Iceland	Signed		
Norway	Signed		
Switzerland	Signed		

#### 4.1.4 Bottlenecks in implementation of e-Call in Europe

Different bottlenecks have been found in different countries (questionnaire of eSafety Support in 2006). The most important are listed below:

- European / International standards are not available yet
- investments needed in the PSAP infrastructure are not yet clearly defined
- upgrading costs of PSAPs
- decentralisation of the E112 service
- concerns from some major stakeholders, including the telecommunication industry
- lack of pilot projects
- lack of public information
- lack of user demand (associated with lack of promotion and advertising of the service and the technology).

#### 4.1.5 Costs of implementation of e-Call

The necessary investments for the implementation of e-Call in Europe are relatively small: €100 (AUD 167) per vehicle and up to €50'000 (AUD 83,500) to upgrade a PSAP. On the basis of this initial investment per PSAP, and the cost of staff training to ensure adequate language support, the total annual cost – including the in-vehicle systems – is around €4.5 billion (AUD 7.5 billion) in the EU.

## 4.2 The e-Call initiative

### 4.2.1 Basics about e-Call

e-Call is an E112 emergency call generated either manually by vehicle occupants or automatically via activation of in-vehicle sensors. The number 112 is the single emergency telephone number for the European Union. Calls to 112 from mobile phones with location information are known as E112 calls. The e-Call product is optimised to trigger an emergency call when a set of standardised sensors in the vehicle reaches a threshold value. The sensors include:

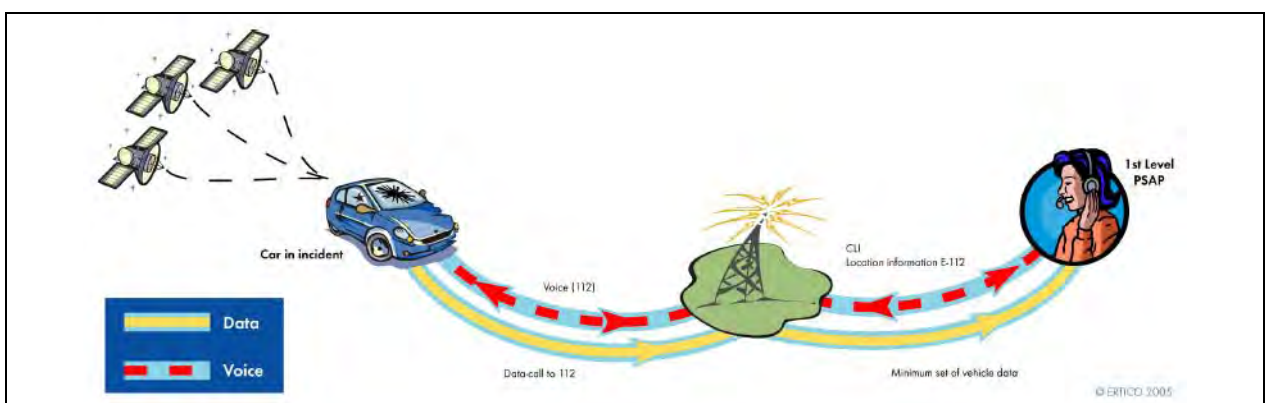
- front crash sensors (two sensors)
- rear crash sensor
- side crash sensor
- SRS airbag sensor
- roll over / vehicle inclination sensor.

To avoid false alarms at least two sensors have to be triggered. In the case of a manually generated e-Call, a double check mechanism avoids unintended e-Calls. A verification of the e-Call via voice link is possible.

The e-Call sends a minimum set of data (MSD) to the PSAP. The mandatory MSD includes:

- time stamp
- precise location, including direction of driving
- vehicle identification
- identification of service provider
- e-call qualifier (as a minimum an indication stating if the e-Call has been manually or automatically initiated).

Figure 26 shows the basic e-Call architecture.



**Figure 26: Overview of the basic e-Call architecture**

[[http://www.esafetysupport.org/en/ecall\\_toolbox/](http://www.esafetysupport.org/en/ecall_toolbox/)]

When an e-Call is generated, the system will also establish a voice connection to the relevant PSAP (Figure 27).

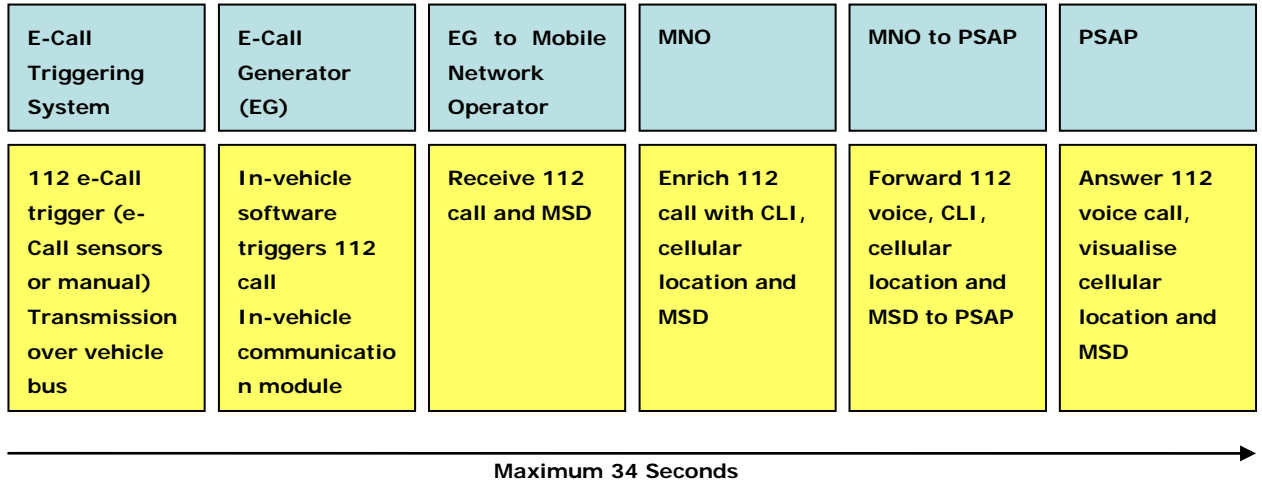


Figure 27: e-Call service chain

The PSAP informs the emergency operators (data and voice). In some countries the PSAP is divided into a two level organisation (Figure 28).

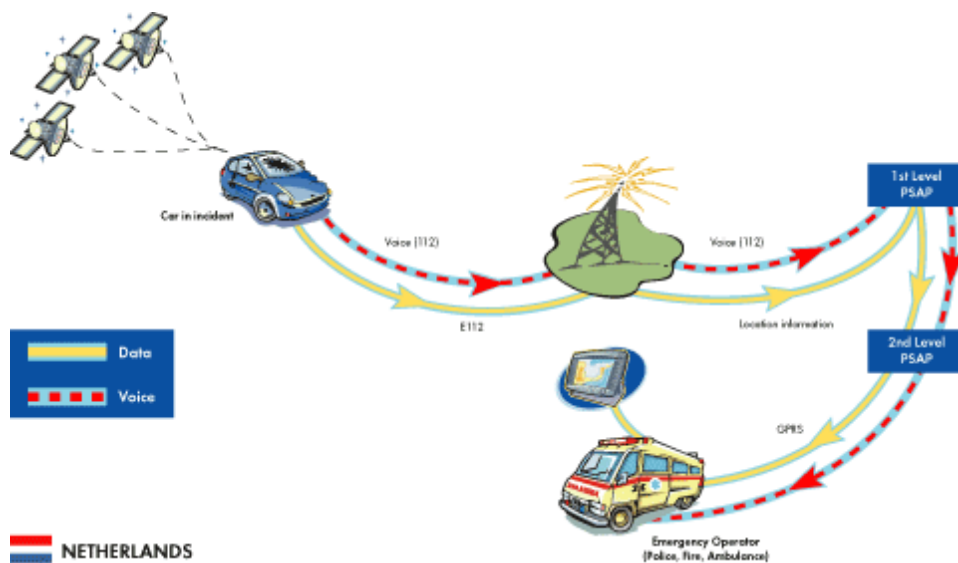


Figure 28: e-Call organisation in the Netherlands with a second level PSAP

[Source: [http://www.esafetysupport.org/en/ecall\\_toolbox/](http://www.esafetysupport.org/en/ecall_toolbox/)]

### Definition of in-vehicle e-Call

The “Memorandum of Understanding of Realisation of an Interoperable In-Vehicle e-Call” supports the following definition of e-Call:



The in-vehicle e-Call is an emergency call generated either manually by vehicle occupants or automatically via activation of in-vehicle sensors. When activated, the in-vehicle e-Call system will establish a voice connection directly with the relevant PSAP (Public Safety Answering Point), this being either a public or a private e-Call centre operating under the regulation and/or authorisation of a public body. At the same time, a minimum set of incident data (MSD) will be sent to the e-Call operator receiving the voice call.

### Advantages of e-Call

According to the results of an analysis conducted by the European Commission supported E-MERGE project (see later section on EU research projects), e-Call will allow a reduction of accident response time of about 50% in rural areas and up to 40% in urban areas (Figure 29).

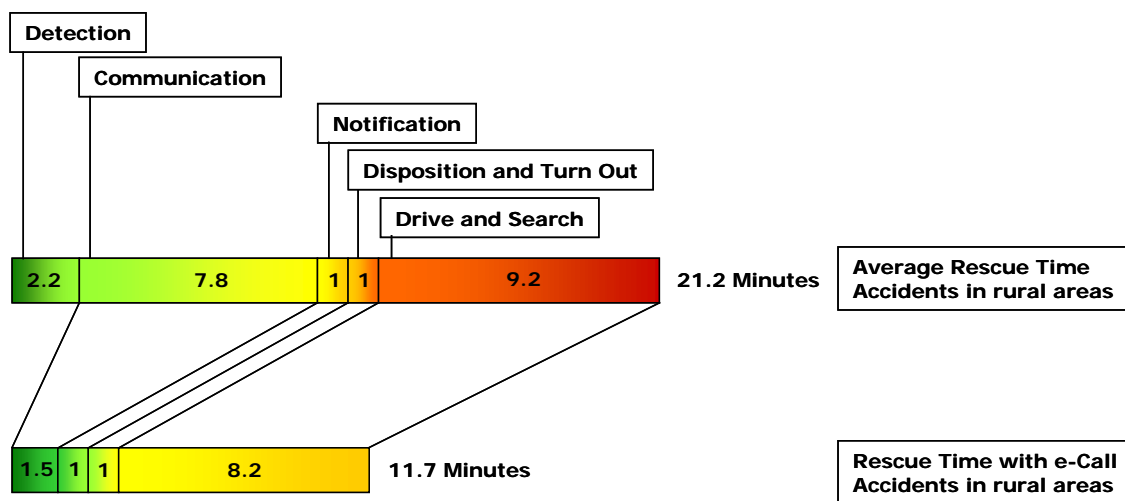


Figure 29: Time saving with e-Call in rural areas

When access to medical care for the severely injured can be provided quickly after an accident, the death rate and severity of trauma can be reduced significantly. Estimates for e-Call indicate that up to 2,500 lives can be saved per year in the European Union, and that there could be up to a 15% reduction in the severity of the injuries, improving healing and recovery outcomes. As regards to economic savings up to €26 billion (AUD 43 billion) could be saved per annum if all cars were equipped with e-Call.

Road accidents can also lead to traffic congestion as well as secondary accidents. By facilitating a shorter rescue time, e-Call can reduce traffic congestion associated with an accident by up to 20%. It also enables other road users to be informed about the incident more quickly.

Even in situations where the driver is unconscious, a safe automatic call is guaranteed. No false alarms are expected (at least two sensors and double-check mechanism when triggered manually), and a verification of the e-Call via voice link is possible. The PSAP receives direct, real-time MSD with all relevant information.

Due to the standardisation process in Europe, e-Call technology will work in any EU Member state plus Iceland, Norway and Switzerland.

#### 4.2.2 e-Call Stakeholders

The key players involved in the e-Call process are members of four large stakeholder groups (Table 6):

- automotive industry
- mobile telecommunication industry
- public emergency authorities and associated or cooperating service organisations
- public social security organisations and private insurance companies.

**Table 6: e-Call stakeholders**

• Stakeholder	• Function / Responsibility
• Automotive industry	• The industry needs to implement the hardware for e-Call in the vehicle. The sensors have to be installed as well as the button for a manually generated e-Call.
• Mobile telecommunication industry	• Enough capacity on the network for e-Calls (voice and MSD) has to be allocated by telecommunication companies. They also have to enrich the 112 call with cellular location. It is important that there are no delays in the transmission of the e-Call.
• Public emergency authorities and associated or cooperating service organisations	• This stakeholder has to ensure that e-Calls can be answered within a reasonable time. That means enough staff are available and trained to handle e-Calls. The infrastructure of the PSAPs has to be ready to handle e-Calls. The whole chain to emergency services has to be without gap (voice and data).
• Public social security organisations and private insurance companies	• These organisations and companies should support and promote e-Call in order to reach the benefits of reducing the rate of injured and deaths. To make e-Call more appealing, the insurance companies should give drivers who implement e-Call infrastructure in their vehicles some kind of benefits.

#### 4.2.3 Overview of projects

##### 4.2.3.1 EU research projects (with involvement of ERTICO)

###### E-MERGE – Project



- Start April 2002
- End June 2004

The E-MERGE project developed a Pan-European harmonised in-vehicle e-Call system based on the European emergency call number 112. E-MERGE determined the functional architecture for sending information - together with the 112 voice call - directly to the emergency services in case of a vehicle incident.

Key decisions of this project are that the 112 number will be used for both voice and data. A minimum set of data (MSD) is sent on the voice channel. This information includes details about where and when the accident occurred, vehicle identification, and information about the severity of the crash. Once implemented on a pan-European level, such a system will enable a faster and more accurate emergency response.

E-MERGE developed prototypes and demonstrated the e-Call concept by opening up a direct e-Call communication link based on 112 and data transmission of a defined and agreed message from Opel, Volvo, Fiat and SEAT test vehicles directly to PSAPs in Sweden, Germany, UK, Spain, and Italy. A link to private service providers was also created to provide additional information to the PSAPs and an

interface between the above-mentioned PSAPs and service providers in Sweden, Italy, Spain, Germany, UK and the Netherlands was tested.

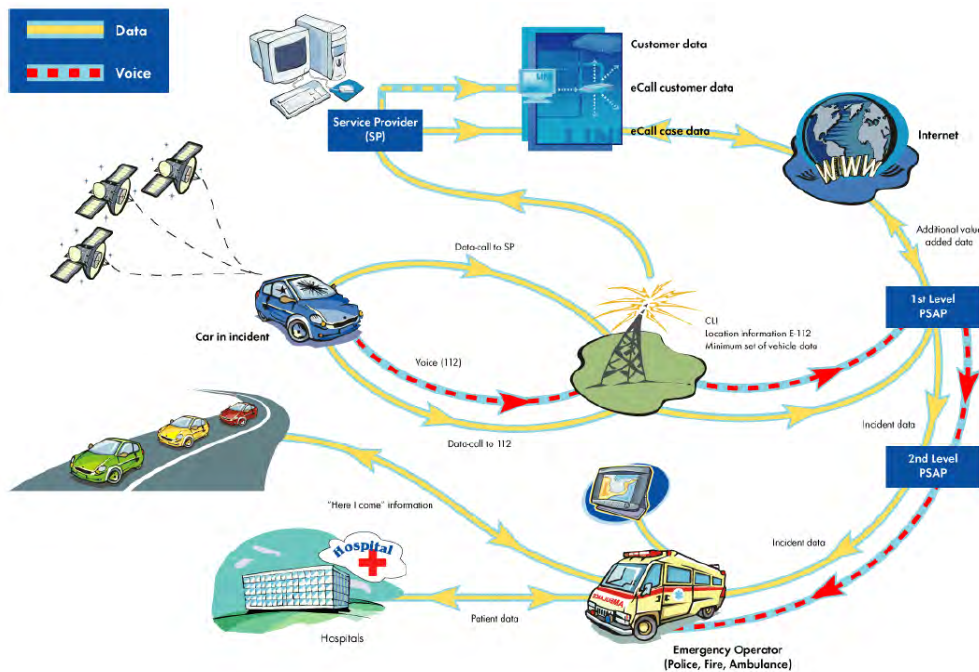
**GST RESCUE – Project**



- Start June 2004
- End Final report expected in March 2007

GST RESCUE followed the E-MERGE project. The project ensures that data from in-vehicle originated e-Calls is transmitted to the different levels of PSAPs and reaches the emergency service vehicles in order to provide a faster and more effective emergency response (Figure 30).

Furthermore, GST RESCUE concentrates on the efficiency of the rescue operations in which the aim is to optimise the security and speed of the emergency vehicles to reach the incident scene. This includes a hybrid navigation solution for the emergency service vehicles and a "blue corridor" system using vehicle-to-vehicle communication that notifies other road users of the approaching emergency vehicle. The safety of the incident scene is then ensured with a "virtual conning" system that transmits warnings about the incident to approaching road users. After the emergency vehicle leaves the scene, remote reporting and transfer of relevant data to hospitals is then made possible.



**Figure 30: Architecture of GST RESCUE**

[[http://www.gstforum.org/en/subprojects/rescue/about\\_gst\\_rescue/system\\_overview/](http://www.gstforum.org/en/subprojects/rescue/about_gst_rescue/system_overview/)]

### eSafety Driving Group on e-Call



- Start November 2002
- End Submitted final report November 2006

The Driving Group on e-Call is one of the Working Groups established by the European Commission under the eSafety Forum. eSafety is a joint industry/public initiative for improving road safety by using new Information and Communications technologies.

The European Commission has reached the conclusion that, within the eSafety Forum framework, the objectives of its mission have been reached and that no further progress is possible unless “the mandate to progress the development and coordination work among the various e-Call constituencies to achieve the e-Call objective is obtained from the appropriate political environment and with the active and coordinated support of the EC”.

In the recommendations of the final report the e-Call DG noted that the possibility to develop e-Calls hinges on two key factors:

- The willingness of all parties to synchronise their respective efforts.
- Agreement on an economic model and the corresponding financial mechanisms.

To achieve this, it is recommended that the following actions (ranked by their respective priority level) be executed:

- The Member States agree to rationalise and align their respective road emergency capabilities.
- The European Commission takes an active role in encouraging the harmonisation of the operations of the emergency authorities.
- The vehicle manufacturing industry, the mobile telecom industry and the in-vehicle e-Call service providers agree on the necessary standards - both in their own areas and at the interfaces between their respective areas.
- The role of the public and private insurance services in the e-Call economics are further investigated by the e-Call DG.

### CGALIES - Project

#### **C.G.A.L.I.E.S**

- Start May 2000
- End Final report released in February 2002

When the Coordination Group on Access to Location Information by Emergency Services (CGALIES) was set up, its main tasks were to identify the relevant implementation issues with regard to enhancing emergency services in Europe with the provision of location information, to analyse and describe them, and to build a consensus on the Europe-wide implementation, involving the views and opinions of all relevant players.

It was recognised that, although some issues are perhaps better resolved at a national level, it might be important and appropriate to discuss them at the European level to facilitate the consensus building process. In order to accomplish its task, CGALIES has organised its work as follows:

- Work Package 1 (WP1): Minimum ‘standards’ on location data accuracy, reliability and evolution path. Minimum requirements for location reference system.
- Work Package 2 (WP2): Minimum functional ‘standards’ for routing and networks. Minimum ‘standards’ on databases. Minimum ‘standards’ for PSAPs.
- Work Package 3 (WP3): Analysis of financing and costs and how this relates to type (and quality) of service and other implementation issues.

#### 4.2.3.2 Selected National Pilot Project



- Start July 2006
- End September 2006

In Austria, the Ministry of Transportation, Innovation and Technology (Bundesministerium für Verkehr, Innovation und Technologie) BMVIT and partners Dolphin Technologies, the Austrian automobile-, motorbike and touring club ÖAMTC and mobilkom austria conducted a pilot project concerning e-Call. One hundred voluntary test drivers, elected out of 1000 applicants, took part in this project.

For the e-Call pilot project, the GPS Tracking System Satalarm from Dolphin Technologies was used. This System is equipped with an external crash sensor and a red emergency button. The SIM-Card from mobilkom austria inside the unit ensured the communication. After triggering an alarm, the ÖAMTC operation centre was informed in two different ways. An SMS-message that was reformatted to an e-mail on the IT-Platform TELECOMMANDER from mobilkom austria was sent. This e-mail included all relevant data regarding the driver and the vehicle as well as the position where the alarm message had been sent from. The data of the closest PSAP was also stated. At the same time, a voice call to a special telephone number of the operation centre was triggered, and the integrated voice processor informed about the reason of the alarm (accident, emergency, theft) and the identity of the vehicle. It was also possible to request the current position of the car using geographic coordinates.

Each of these 100 test drivers had to trigger at least 10 alarms (with a maximum of 12). A simulated accident alarmed the operation centre, which had to recall the driver on the given cell phone number. The operation centre had to clarify if the alarm was an e-Call test or a real case of emergency and if the transmitted position of the car was correct. Then the test driver had to complete his test driver pass with the time of the alarm, the time of the recall from the operation centre, and the validation of the transmitted position. After completion of the required test alarms, the test drivers had to transfer the results to the e-Call homepage. The ÖAMTC operation centre logged the delay between the e-mail alarm and the voice call. Mobilkom austria also evaluated the incoming voice calls and the alarms via SMS. The results showed that 72% of all alarms were answered within two minutes.

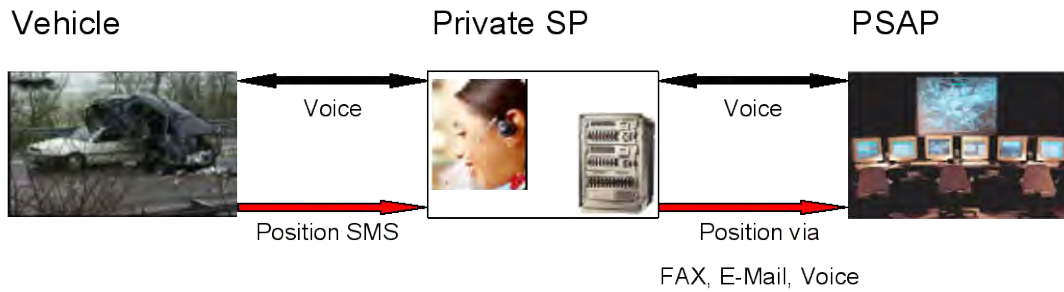
There was also a questionnaire for the test drivers. Sixty per cent of them would pay between €9 and €14 (AUD 15 and AUD 23) per month for the system. Nearly one in two test drivers indicated willingness to pay at least €300 (AUD 500) for the unit (hardware) and the installation.

**4.2.3.3 Commercial projects**

Different car manufacturers (for example BMW and Volvo) offer solutions similar to e-Call.

These solutions are on a private basis and the e-Call does not go directly to the nearest PSAP but to a Private Service Provider. When they are unable to talk with the driver/vehicle occupants or when emergency services are needed, the Private Service Provider informs the PSAP and provides information about the position of the vehicle and the vehicle itself. The Private Service Provider gets a full set of data (FSD) including vehicle identification.

The vehicles are fitted with a GPS receiver and an integrated GSM phone. No additional SIM card is needed from the driver. The service works in several countries in Europe (cross-border) and is being expanded continuously (Figure 31).



**Figure 31: Current private solution e-Call architecture**



#### 4.2.4 Additional services

Value added services with e-Call could be that service provider databases include additional data to the communication such as :

- personal data
- who to inform (e.g. relatives, employer)
- health information
- towing contracts
- insurance information.

This data set is called a full set of data (FSD). The PSAP does not need a FSD, as their field of responsibility does not include informing towing companies or insurance issues (Figure 32).

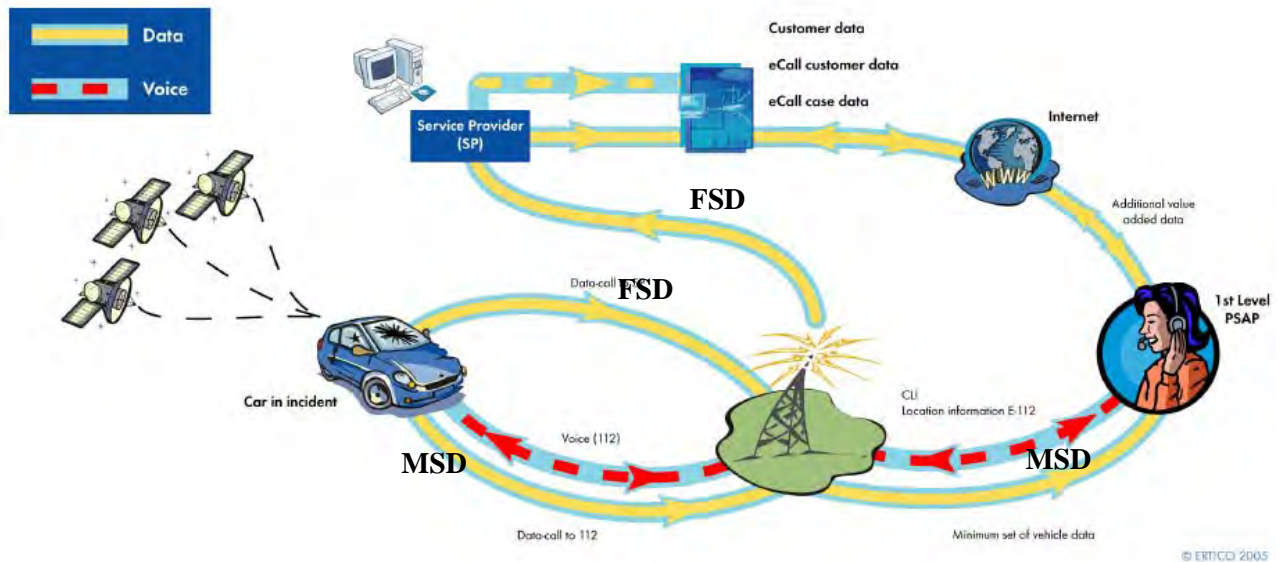


Figure 32: Possible full e-Call architecture with value added services

[[http://www.escope.info/download/ecall\\_toolbox/Meetings/Service\\_Providers/ecallserviceprovidermeeting.pdf](http://www.escope.info/download/ecall_toolbox/Meetings/Service_Providers/ecallserviceprovidermeeting.pdf)]

### 4.3 Regulatory documents

#### 4.3.1 EU Regulations

The following EU Regulations are of relevance with respect to e-Call:

- 91/396/EEC: Council Decision of 29 July 1991 on the introduction of a single European emergency call number
- Directive 2002/22/EC of the European Parliament and of the Council of 7 March 2002 on universal service and users' right relating to electronic communications networks and services (Universal Service Directive)
- Directive 2002/58/EC of the European Parliament and of the Council of 12 July 2002 concerning the processing of personal data and the protection of privacy in the electronic communications sector (Directive on privacy and electronic communications)
- COM(2001) 370 European transport policy for 2010: Time to decide
- COM(2003) 311 final European Road Safety Action Programme: Halving the number of road victims in the European Union by 2010: A shared responsibility
- COM(2003) 542 final Information and Communications Technologies of Safe and Intelligent Vehicles
- COM(2003) 2657 final
- COM(2005) 431 final Bringing eCall to Citizens
- COM(2006) 59 On the Intelligent Car Initiative: raising Awareness of ICT for Smarter, Safer and Cleaner Vehicles
- COM(2006) 723 final Bringing eCall back on track – Action plan.

#### 4.3.2 National Regulations

No national regulations are known yet.



#### 4.4 Additional information

##### 4.4.1 WEB Links

WEB links of European project sites concerning e-Call:

• Link	• Organisation / Country	• Remarks
• <a href="http://www.e-merge.org">http://www.e-merge.org</a>	• European Commission	
• <a href="http://www.gstforum.org/en/subprojects/rescue/about_gst_rescue/about_gst_rescue.htm">http://www.gstforum.org/en/subprojects/rescue/about_gst_rescue/about_gst_rescue.htm</a>	• European Commission	
• <a href="http://www.ertico.com">http://www.ertico.com</a>	• European Commission	
• <a href="http://www.esafetysupport.org/en/ecall_toolbox/">http://www.esafetysupport.org/en/ecall_toolbox/</a>	• European Commission	

WEB Links of governmental / national sites concerning e-Call:

• Link	• Organisation / Country	• Remarks
• <a href="http://www.ecall.fi/indexe.html">http://www.ecall.fi/indexe.html</a>	• Finland	
• <a href="http://www.e-call.at">http://www.e-call.at</a>	• Austria	

WEB Links of commercial purpose concerning e-Call:

• Link	• Organisation / Country	• Remarks
• <a href="http://www.bmw-telematik.de/frame/ass_06b.htm">http://www.bmw-telematik.de/frame/ass_06b.htm</a>	• BMW, Germany	• In German
• <a href="http://www.volvocars.com/corporation/NewsEvents/News/news.htm?item=%7B304E881E-1E2D-472B-8CD1-6A527BBCD8CB%7D">http://www.volvocars.com/corporation/NewsEvents/News/news.htm?item=%7B304E881E-1E2D-472B-8CD1-6A527BBCD8CB%7D</a>	• Volvo, Sweden	
• <a href="http://www.teleaid.com/index.html">http://www.teleaid.com/index.html</a>	• Mercedes-Benz, Germany	
• <a href="http://www.onstar.com">http://www.onstar.com</a>	• GM, USA	

##### 4.4.2 Information about Memorandum of Understanding

The Memorandum of Understanding can be found at:

[http://ec.europa.eu/information\\_society/activities/esafety/doc/esafety\\_forum/invehicle\\_ecall\\_mou.pdf](http://ec.europa.eu/information_society/activities/esafety/doc/esafety_forum/invehicle_ecall_mou.pdf)

All parties which signed the MoU (Status 15 Dec. 2006):

[http://www.esafetysupport.org/download/ecall\\_toolbox/MoU/List%20of%20signatures%20MoU.pdf](http://www.esafetysupport.org/download/ecall_toolbox/MoU/List%20of%20signatures%20MoU.pdf)

## 5 Tracking and Tracing of Dangerous Goods

### 5.1 Background

#### 5.1.1 Carriage of Dangerous Goods

Carrying goods by road or rail involves the risk of traffic accidents. If the goods carried are dangerous, there is also the risk of an incident such as spillage of the goods, leading to hazards such as fire, explosion, chemical burn or environmental damage. Most goods are not considered sufficiently dangerous to require special precautions during carriage. Some goods, however, have properties which mean they are potentially dangerous if carried.

These risks exist due to the dangerous properties, or state of, the substances. Each day, products defined as dangerous goods that are necessary for maintaining Europeans' quality of life, are transported from one point to another within or throughout Europe. These transportations are too numerous to accurately record, but are estimated to be many millions per year. With this amount of movement, there is great potential for endangering human life and damaging the environment through accidents during transportation. For this reason many countries are currently providing regulations so as to "handle" dangerous goods in terms of packing, loading, transport, unloading and unpacking.

Dangerous goods are liquid or solid substances, and articles containing them, that have been tested and assessed against internationally-agreed criteria - a process called classification - and found to be potentially dangerous (hazardous) when carried. Dangerous goods are assigned to different classes depending on their predominant hazard.

There are regulations to deal with the carriage of dangerous goods, the purpose of which is to protect everyone either directly involved (such as consignors or carriers), or who might become involved (such as members of the emergency services and public). These regulations place duties upon everyone involved in the carriage of dangerous goods, to ensure that they know what they have to do to minimise the risk of incidents and guarantee an effective response.

Carriage of dangerous goods by road or rail is regulated internationally by agreements and European Directives, with biennial updates of the Directives to take account of technological advances. New safety requirements are implemented by Member States via domestic regulations which directly reference the technical agreements.

### 5.1.2 Definition of Dangerous Goods

Dangerous goods are defined as substances that can have harmful effects for humans, environment, and property. The classification of dangerous goods follows the "ADR, Agreement concerning the International Carriage of Dangerous Goods by Roads" of 30 September 1957, that has been included in Annex E of the ECE rules 1172/98, and which has been reported by the directive 2001/7/EC of the 29th January 2001.

- Council Regulation (EC) No 1172/98 of 25 May 1998 on statistical returns in respect of the carriage of goods by road.
- Commission Directive 2001/7/EC of 29 January 2001 amended for the third time due to technical progress Council Directive 94/55/EC on the approximation of the laws of the Member States with regard to the transport of dangerous goods by road.

### 5.1.3 ADR - Agreement

The European Agreement concerning the International Carriage of Dangerous Goods by Road, commonly known as ADR (from French Accord Dangereuses Route), governs trans-national transport of dangerous materials. The ADR is updated every second year to keep pace with technical and judicial progress.

Launched in Geneva on 30 September 1957 under the aegis of the United Nations' Economic Commission for Europe, it first took effect on 29 January 1968. The agreement was modified (article 14, paragraph 3) in New York on 21 August 1975, though these changes only took effect on 19 April 1985. A set of new Amendments entered into force on 1 January 2007 and, consequently, a fourth consolidated restructured version was published as document ECE/TRANS/175, Vol. I and II (ADR 2007).

The agreement itself is brief and simple, and its most important article is article 2. This article states that, with the exception of certain exceptionally dangerous materials, dangerous materials may in general be transported internationally in wheeled vehicles, provided that two sets of conditions are met:

- Annex A regulates the merchandise involved, notably their packaging and labels
- Annex B regulates the construction, equipment and use of vehicles for the transport of dangerous materials.

Among other things the ADR also requires that:

- In most cases the driver has to be in possession of an ADR-driver license.
- All persons involved in the handling and transport have to prove their knowledge of the regulations concerning dangerous goods.
- All companies which transport dangerous goods must have a risk prevention officer.

The ADR regulates

- the structure of containers, tanks, vehicles for the transport of dangerous goods
- exceptions for the compliance with the ADR
- multimodal transport of dangerous goods (road – rail, ship or airplane).

#### 5.1.4 UN-Numbers and ERICards

##### *UN-Numbers*

UN numbers or UN IDs are four-digit numbers that identify dangerous goods, hazardous substances and articles (such as explosives, flammable liquids, toxic substances, etc.) in the framework of international transport.

Most hazardous substances have their own UN numbers (for example petrol is UN1203 [Figure 33]), while groups of chemicals or products with similar properties sometimes receive a common UN number (for example flammable liquid, not otherwise specified, have UN1993).

A chemical in its solid state may receive a different UN number than in its liquid phase if the hazardous properties differ significantly; substances with different levels of purity may also receive different UN numbers.

UN numbers range from UN0001 to about UN3500 and are assigned by the United Nations Committee of Experts on the Transport of Dangerous Goods. They are published as part of their Recommendations on the Transport of Dangerous Goods, also known as the Orange Book. These recommendations are adopted by the regulatory organisation responsible for the different modes of transport.

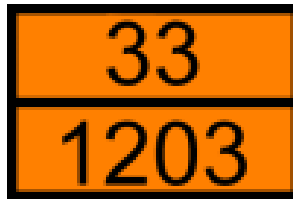


Figure 33: Example of Dangerous Goods tag for Petrol

##### *ERICards*

The CEFIC<sup>2</sup> Emergency Response Intervention Cards (ERICards or ERICs) provide guidance on initial actions for fire crews when they first arrive at the scene of a chemical transport accident without having appropriate and reliable product specific emergency information at hand.

ERICards are intended for fire crews, trained in chemical emergency response, and contain information and procedures that may require specialised equipment.

The issue of the ERICards was realised with the financial support of the European Commission - Directorate General for Energy and Transport (DG TREN).

[<http://www.ericards.net/>]

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<sup>2</sup> European Chemical Industry Council based in Brussels ; <http://www.cefic.be>

## 5.2 Tracking and Tracing of Dangerous Goods Projects

### 5.2.1 Commercial or Governmental Projects

As far as the authors know, no commercial or governmental system of tracking and tracing of dangerous goods is in operation at the moment. Various indicative and research projects have been launched but none has been migrated into operation.

One of the main issues is to prepare the legal framework, regulations and standards to implement tracking and tracing of dangerous goods applications across Europe.

### 5.2.2 Research Projects

#### 5.2.2.1 TradgGIS - Project

The Finnish Ministry of Transport and Communications has, together with several other organisations, participated in the large scale TradgGIS project, financed by the EU-Life fund. The aim of the project has been to create a GIS-based tool for managing environmental risk associated with the transport of dangerous goods. As part of the TradgGIS-project, a classification system for environmental risk factors, based on the soil and water properties of the transport routes, was developed. Simultaneously, an IT tool, aimed at enhancing mitigation measures both in the planning stages and during immediate and longer term clean-up operations, was developed.

The system was piloted in Central Finland during the summer of 2000. Once the Life project ended, the resulting GIS-based data management system was made available via the Ministry of Transport and Communications web site under the name VAKSU<sup>3</sup> - a tool for planning dangerous goods transport.

The usability of the VAKSU tool in its current format and current site has been poor. In a separate project in 2005, the possibilities to enhance the usability of the VAKSU tool were assessed. The objectives of the project were to:

- assess the interest different organisations and authorities have in using and developing the VAKSU system
- clarify the preconditions for extending the system to cover new areas in Finland
- evaluate the potential best site for the system and the system maintenance prerequisites
- achieve a commitment from key authorities to participate actively in the use and development of the VAKSU system.

The findings from the project are presented as two potential routes for enhancing the usability of the VAKSU system.

TradgGIS is a fast, efficient, internet-based geographic information system (GIS) in real time for Finland. A risk classification of traffic areas has been created. The main objective of the classification was to assist in soil and water conservation. The traffic areas were divided into smaller parts that represent different environmental risk types. Later the data was transferred into the GIS. The data stored in a GIS database can easily be used and modified for environmental management purposes.

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<sup>3</sup> Finnish: Vaarallisten aineiden kuljetusten suunnittelutyökalun (VAKSU) - Enhancing the usability of a tool for planning transport of dangerous goods



Figure 34: Architecture of the TradGIS system

The main functions of the pilot system were the following:

1. **Input of Transport Data**

Data of the transport task and the cargo were entered into the database by using a web-form of the TradGIS system. This had to be done by the driver or the company.

2. **Observation of the Position and Status of the Transport**

The system received the positional data of the vehicle based on certain criteria. The position could be determined by time intervals or when the vehicle entered certain area. Authorised users could see the position of the vehicles by the www-browser on a zoomable map. The system received the positional data and alarm from the vehicle in the event of an accident. When a vehicle carrying dangerous goods was involved in an accident, an alarm was passed via the system to the users. Details of the accident were received by all users connected to the system. Connection to the system via the Internet may have been of the fixed link or wireless variety. The alarm and the messages concerning the position of the vehicle were passed to the system as SMS via GSM network.

3. **Control of an Accident**

In the event of an accident the last data received regarding position, transported goods, the circumstances of the accident site (i.e. the risk classification of the traffic area), the operation instructions and contact information of specialists were obtained from the system. The system also sent a notice to predefined e-mail addresses.

4. **Examination of Previous Accidents**

Accidents could be searched for from the database by position, time and by transported goods.

The GIS was responsible for storage and use of the following data:

- risk classification of the traffic areas including operation instructions
- surface water, ground water and soil conditions
- map data
- data of an ongoing transport task
- data concerning the cargo
- contact information of specialists
- occurred accidents.

A centralised server environment maintained the system data. The end user communicated with the server using a web browser (Figure 34).

The information systems aim only to control the transportation of dangerous goods were usually based on the needs of authorities. Reasons for implementing control systems could be

- promotion of environmental, population and traffic safety
- compilation of statistics
- evaluation of companies, drivers or vehicles in comparison with the regulations (e.g. ADR regulations).

[\[http://www.ymparisto.fi/default.asp?contentid=89673&lan=fi\]](http://www.ymparisto.fi/default.asp?contentid=89673&lan=fi)



### 5.2.2.2 MITRA - Project



The MITRA-project (Monitoring and Intervention for the TRAnspOrtation of Dangerous Goods) was funded by the European Commission under the 6th Framework Programme (IST priority).

It started on 1 September 2004 and the project duration was 24 months. Field tests were held in March 2006. The MITRA consortium involved different European actors like civil security authorities, research organisations, and industrial companies (Figure 35).

The key objective of the MITRA project was to develop and test a functional demonstrator for the monitoring of dangerous goods, intended to support European Civil Security Centres for crisis management in case of accidents.

MITRA also contributed to pave the way to the evolution of the European legislation in terms of dangerous goods transportation, through a long-haul dissemination campaign.

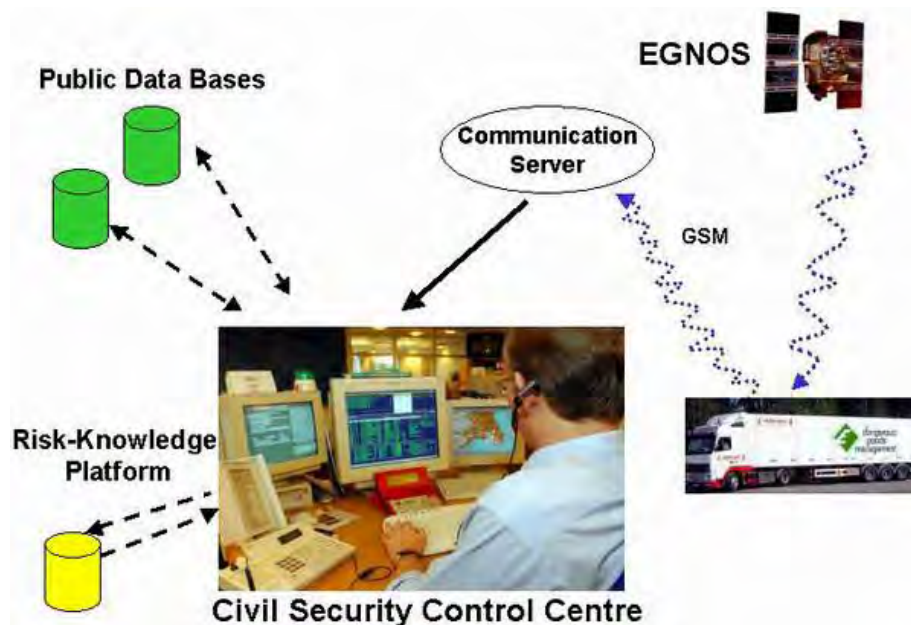


Figure 35: MITRA system stakeholders

[[www.mitraproject.info](http://www.mitraproject.info)]

The MITRA demonstrator provided the Civil Security Centres with real-time knowledge of the position of the vehicles and information on the freight circulating in the areas of their responsibility. Furthermore, the system generated warning and alert displays in case of dangerous situations, and provided information required for crisis management operations in case of accidents.

Such a system assists intervention teams to react immediately in case of distress with maximum efficiency and safety. Several French, German and Spanish project partners with expertise in the domains of transport of dangerous goods, risk prevention and crisis management, satellite positioning and Geographic Information Systems (GIS) had joined the MITRA project to meet these objectives. The Civil Security authorities from Spain, France, Germany and the Netherlands were actively involved in the project, as experts for the user requirements collection and as end-users for the system deployment and validation campaign.

Figure 36 shows an overview of the MITRA system architecture.

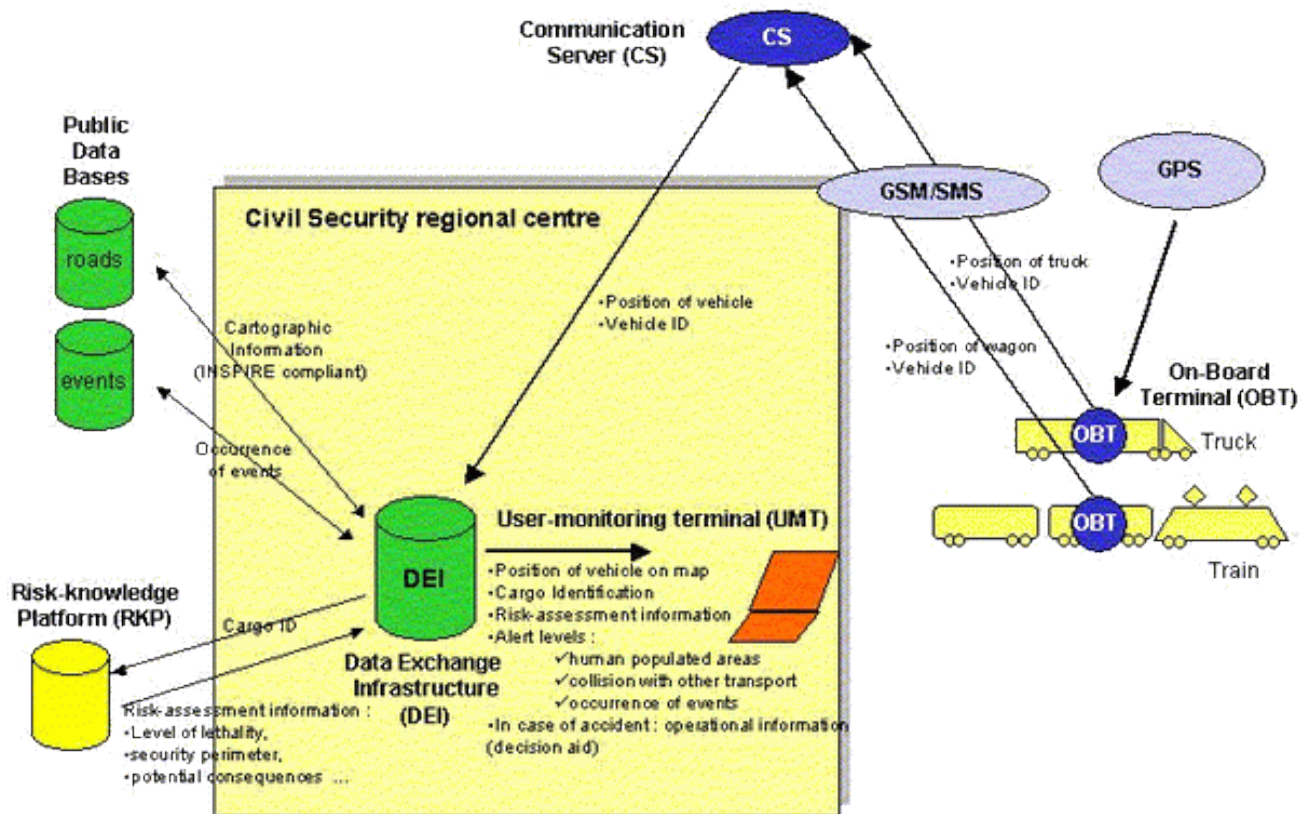


Figure 36: Details of the architecture of the MITRA system

[www.mitraproject.info]

The position information derived from the MITRA On-Board Terminal was transmitted (together with the vehicle ID) using GSM/SMS via the MITRA Communication Server to the Data Exchange Infrastructure (DEI). The DEI had interfaces to the MITRA Public Data Bases (containing various spatial information) and the MITRA Risk-Knowledgement Platform. The integration of those two components of the MITRA demonstrator into a standard GIS enabled the operator in the regional Civil Security Centre to monitor the floating vehicles, identify dangerous situations, and react properly in case of accidents.

The visualisation of the mobile vehicles, the geographic environment and specific information related to the transport of dangerous goods was based on 2D and 3D GIS tools. Typical examples are shown in Figure 37.



Figure 37: Visualisation of the GIS tools

In order to validate the MITRA system against the user requirements identified in the very first phase of the project, field tests were organised in Germany (road and rail) and in the border area between Spain and France (road). Three regional Civil Security Centres (Spain, France, Germany) were involved in these field tests (Figure 38).

The test scenario in Germany focused on the usability of the MITRA system for different modes of transport (road and rail) and assessed the quality of the positional information and the communication link in different environments (urban, sub-urban, rural, and mountainous).

The MITRA functional demonstrator was based on GPS, but additional measurements were performed to assess the benefits of EGNOS and Galileo for a future operational system. The trials in the French / Spanish border region focused on the hand-over of a vehicle between the control centre in Barcelona and the control centre in Valabre (near Aix-en Provence).



Figure 38: Civil security centres used for the field tests [MITRA]

[www.mitraproject.info]

### 5.2.2.3 GOOD ROUTE - Project



GOOD ROUTE - project deals with Dangerous Goods Transportation Routing, Monitoring and Enforcement and is funded by the European Commission. It started 1 January 2006 and will last for 36 months.

GOOD ROUTE aims to develop a cooperative system for dangerous goods vehicles through route monitoring, re-routing (in case of need), enforcement and driver support, based upon dynamic, real time data, in order to minimise the societal risks related to their movements, whilst still generating the most cost efficient solution for all actors involved in their logistic chain.

For this scope, a new classification scheme of the dangerous goods (according to ADR) with infrastructure based safety measures, context of transportation (i.e. level of loading) and vehicle characteristic, will be performed, dynamic data collection and fusion will be realised from Infrastructure to Vehicle (I2V)/ Vehicle to Vehicle (V2V) sources and a series of on-board sensors, risk calculation algorithms will be realised, leading to a new route guidance function: the "minimum risk route guidance". The system will be integrated with an automatic, local node based, enforcement functionality and tested in three pilots throughout Europe (in Finland, Switzerland and Italy), with emphasis on densely populated areas, tunnels, and bridges. In addition, rerouting info and estimated delays will be communicated to the vehicles logistic chain, thus optimally combining safety with transportation efficiency enhancement.

The management of risks involved in the transportation of dangerous goods has become a necessity. This process should include early recognition of potential problems (by on-board units and infrastructure based info; both in a dynamic manner), information about actual cargo and driver status, optimal routing and/or re-routing and monitoring and enforcement of dangerous goods movements within the transportation network.

#### Project Objectives

This aim of GOOD ROUTE is approached through the following main objectives:

- Development of a classification system and ontological framework between dangerous cargo, vehicle types and road infrastructure elements, to automatically permit or re-route specific dangerous good vehicles through specific road infrastructures (i.e. tunnels, long bridges, etc.)
- Development of a collaborative platform that is able to gather and process real time vehicle and cargo data as well as environmental data (road status, unexpected obstacles, weather conditions, population density) as input to an optimal routing and route guidance system
- Development of a minimum risk guidance system that is able to route and re-route dangerous goods vehicles, taking into account individual and societal risk (based upon the collaborative platform based dynamic data), as well as conflict resolution and equity schemes
- Develop a Control Centre algorithm, to oversee the routing and monitoring of all dangerous goods vehicles within a certain geographical area, provide the necessary traffic and environmental data to them and inform in real time their logistic chain for any unscheduled re-routing required.



- Develop an on-board automatic data retrieval and storage system, to monitor key dangerous goods vehicle parameters (actual vs. planned route, speed, weight per axle, etc.), able to supply it to local nodes (i.e. police car at toll station or before tunnel/bridge, etc.), for enforcement purposes.
- Develop optimal user interfaces for both the drivers of the dangerous goods vehicle and the control operator, to provide them with appropriate information and/or warning, without causing them workload enhancement or other unnecessary behavioural adaptations
- Integrate all functions on top of a vehicle prototype and test them in three pilot sites, Europe wide, to evaluate their reliability, usability, successfulness, cost-efficiency and thus estimate their potential safety impact and viability
- Involve all key actors in the dangerous goods transportation chain, as well as OEMs and sensor suppliers; to result in an optimal business strategy for wide and quick diffusion of the above system.

[<http://www.goodroute-eu.org>]

#### 5.2.2.4 ERA-NET TRANSPORT - Project



The ERA-NET TRANSPORT for the period 2004-2007 comprised 13 partners from 11 European countries that aimed at efficient trans-national research cooperation in the field of transport especially from a transport policy point of view.

Transport telematics has proven to be one of the most important areas of co-operation in this sense.

The objective of participating in the exhibition was:

a) to promote the ERA-NET idea in the field of transport

and

b) networking and engaging stakeholders in concrete ongoing actions in transport telematics (other countries, other ERA-NETs):

- real-time data collection
- trans-national architecture for multimodal information
- business models for data collection and use
- driver support systems
- tracking and tracing of dangerous goods.

[<http://www.transport-era.net/>]

### 5.2.2.5 SISTER - Project



Making road transport more intelligent with satellite communications.

The SISTER - “Satcoms in Support of Transport on European Roads” - project will promote the integration of satellite and terrestrial communication with Galileo, the European satellite navigation system.

The project’s goal is to enable mass-market take-up by road transport applications. SISTER-project is funded through the EC DG Enterprise and Industry and will last from November 2006 until November 2009.

Satellite navigation services have already proved their value in a large range of road transport applications. Many of these applications require one or two-way communications services in order to function. In many cases to date, terrestrial communication systems such as GSM and GPRS have been employed. However, there are numerous circumstances in which these technologies may not be sufficient to meet the communications requirements. These include:

- high-availability applications in which communications coverage must be comprehensive, such as emergency applications
- high-reliability applications in which guaranteed quality of service is required, such as dangerous goods tracking
- high-capacity applications in which the terrestrial network infrastructure may be too expensive for the distribution of large volumes of data to many users, such as digital maps updating.

Although satellite communications do not replace the need for terrestrial services in many of these applications, they do serve to complement them and thus lead to a superior overall solution.

To validate the project’s results, five application demonstrations will be carried out at test sites across Europe:

- eCall (Sweden)
- Map updating (Austria, Germany and Slovenia)
- Road user charging (Czech Republic)
- Dangerous goods, integrated testing of eCall, map updating and road user charging (Belgium and the Netherlands)
- Enhanced Galileo services (UK).

The objectives of SISTER include:

- Define where, how and when satellite communications can be used and make recommendations for future research and development in the field.
- Identify how applications need to be adapted in order to use satellite communications.
- Specify and develop a prototype of an integrated satellite communications transceiver that supports integrated GNSS/mobile and satellite communications.
- Develop a prototype of a reconfigurable Galileo receiver.
- Define requirements for a satellite system suitable for providing services to the road transport market.
- Evaluate the performance of Real Time Kinematic-enhanced Galileo positioning technology, optimise its operation and evaluate the benefits of this improved performance for ITS applications that use position data .

[[http://www.ertico.com/en/activities/efficiency\\_environment/sister.htm](http://www.ertico.com/en/activities/efficiency_environment/sister.htm)]

### 5.2.2.6 EMOGES - Project



EMOGES covered the evaluation of positioning technologies for the monitoring of hazardous goods transports on the high-level Austrian express-road network. It was part of the Austrian ARTIST Programme (Austrian Radionavigation Technology and Integrated Satnav services and products Testbed). EMOGES was launched in February 2003 and lasted until April 2004.

Previous experiences with grave accidents in road tunnels (for example, Tauern Tunnel and Mont Blanc Tunnel 1999) have confirmed the weak points in the management of dangerous goods transport as well as the extreme danger of such transport at critical sections of the high-level express-road network. Dangerous goods transport represents an extremely high safety risk, especially in areas with high traffic volumes, in sensitive ecological environments, and particularly in tunnels.

Only complete tracking of dangerous goods transport along all the sections of the high-level express-road network provides a sufficient data stock in order

- to ensure the safety of road users and all the residents in these critical sections of the roads
- to guarantee the basis for efficient emergency management.

The availability of satellite navigation systems could not be guaranteed along the whole Austrian TERN, due, for example, to shadow effects in tunnels and shadow effects of high buildings. It was therefore necessary to develop complementary technologies for these areas, such as video imaging processes, infrared / microwave based technologies, tolling system of ASFINAG<sup>4</sup>, to build up a dangerous goods monitoring (DGMS) system without interruption along the whole Austrian TERN.

To ensure these goals, EMOGES identified system parameters for the use of positioning and communication technologies in DGMS, worked out a strengths/weakness analysis of positioning and communication technologies and defined the “handshake” between areas with satellite reception and without, for example tunnels.

EMOGES also included a demonstration scenario and a microeconomic analysis of different positioning and communication technologies to increase / upgrade the acceptance of new technologies, for example GALILEO, EGNOS.

EMOGES focused on the demonstration of value added services for the management of dangerous goods transports on the Austrian TERN, whereby demonstration scenarios for two different road areas have been covered. On the one hand new technologies (GALILEO, EGNOS etc.) and conventional technologies (NAVSTAR) for areas satellite reception and on the other hand technologies for areas without satellite reception (video imaging processes, infrared/ microwave based technologies, tolling system of ASFINAG) have been analysed.

The main achievement of EMOGES was to provide a best practise concept of value added services for the management of dangerous goods transports on the Austrian TERN.

[http://www.its-austria.info/uploads/tx\\_userprojekte/project\\_description\\_emoges.pdf](http://www.its-austria.info/uploads/tx_userprojekte/project_description_emoges.pdf)

<sup>4</sup> Autobahn- und Schnellstraßen-Finanzierungs-Aktiengesellschaft, Austrian Motor- and Expressway Operator.

### 5.3 Status of TTDG in Europe

#### 5.3.1 Reasons and Findings about TTDG

Reasons to implement systems for TTDG include among others:

- The emergency organisations do not have the accuracy and competence desired by the public to deal with accidents involving vehicles carrying dangerous goods.
- The need for a system to enable a better, faster and more precise rescue.
- Faster and more precise reaction of the Civil Security Centres and rescue teams / emergency services.

Companies (industry and transport) do not usually have to exceed the requirements of transport legislation. However, the information systems developed to monitor the transportation of dangerous goods are always based on the information relating to the transport task (vehicle, route, schedule, position etc.). This data can only be provided by the companies.

Other difficulties are the precision of maps (emergency services) and the lack of an incident alert system. In tunnels, positioning with GPS is not possible.

During the TradgGIS project a couple of problems related to these topics were identified:

- How to motivate the companies to release transport data to the authorities' systems?
- Is it possible to specify generally acceptable methods of action and data transmission effectively into the authorities' systems in order to obtain the required data from the companies? The companies cannot be expected to enter information manually into the systems. Input must be automated.

Requirements of systems for TTDG include but are not limited to:

- knowledge of the exact position of the vehicle and the load
- automatic alert about any findings of vehicle diagnostics systems
- automatic alert in case of incidents and accidents including information about the area where an accident happened
- automatic transmission of UN-Number and ERICard content together with the emergency call / e-Call to emergency organisation.



### 5.3.2 Status

Previous experiences with grave accidents in road tunnels (e.g. Tauern Tunnel and Mont Blanc Tunnel 1999, Gotthard Tunnel 2001) have confirmed the weak points in the management of dangerous goods transport as well as the extreme danger of such transport at critical sections of the high-level express-road network. Dangerous Goods Transport (DGT) represents an extremely high safety risk, especially in areas with high traffic volumes, in sensitive environmental / ecological environments, and particularly in tunnels. The mentioned accidents in road tunnels in Austria, France and Switzerland have launched numerous initiatives, activities and programmes all across Europe. In particular tunnel safety has become a major topic in the context of improved road and transport safety. But also in the area of Tracking and Tracing of Dangerous Goods Transports (TTDG) numerous research projects have been launched and pilot systems have been tested. Nevertheless as far as the authors know from the numerous research and pilot projects launched across Europe none of them has been migrated into real operation. Therefore no commercial or governmental system for TTDG is in real operation at the moment.

Apparently the introduction of systems for TTDG is rather complex and additional efforts are required before TTDG will become a standard application. The reasons why TTDG has not yet been implemented in Europe include:

- lack of European regulations and standards to implement Tracking and Tracing of Dangerous Goods Applications across Europe
- complexity of requirements, approach and necessary measures to be taken to guarantee proper functionality of TTDG
- operation and maintenance of TTDG is complex and considered to be very costly.

Due to the risk and dangers of transport of dangerous goods, more sophisticated monitoring is obviously a requirement. However, there is still a long way to go regarding realisation and implementation. The current regulations (for example ADR, etc.) are well-established and proven, but migration / integration into future applications such as e-Call and monitoring of TDG is required and inevitable.

## 5.4 Regulatory documents

### 5.4.1 Agreement concerning the International Carriage of Dangerous Goods by Road

The European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) was signed at Geneva on 30 September 1957 under the auspices of the United Nations Economic Commission for Europe (UNECE), and entered into force on 29 January 1968. The Agreement itself was amended by the Protocol amending article 14 (3) made at New York on 21 August 1975, which entered into force on 19 April 1985.

A set of new amendments entered into force on 1 January 2007, and consequently, a fourth consolidated restructured version was published as document ECE/TRANS/175, Vol. I and II (ADR 2007).

All EU member countries have signed the ADR and the ADR is also backed-up by valid EU-Regulations.

### 5.4.2 EU Regulations

The following EU Regulations are of relevance with respect to the transport of dangerous goods and safety in tunnels:

- Council Directive 94/55/EC of 21.Nov.1994 on the approximation of the laws of the Member States with regard to the transport of dangerous goods by road
- Council Directive 95/50/EC of 06.Oct.1995 on uniform control procedures for the road transport for dangerous goods
- Directive 2000/18/EC of the European Parliament and of the Council of 17 April 2000 on minimum examination requirements for safety advisers for the transport of dangerous goods by road, rail or inland waterway
- Directive 2000/61/EC of the European Parliament and of the Council of 10 October 2000 amending Council Directive 94/55/EC on the approximation of the laws of the Member States with regard to the transport of dangerous goods by road
- Commission Directive 2001/7/EC of 29 January 2001 amending for the third time due to technical progress Council Directive 94/55/EC on the approximation of the laws of the Member States with regard to the transport of dangerous goods by road (Text with EEA relevance)
- Commission Directive 2003/28/EC of 7 April 2003 amending for the fourth time due to technical progress Council Directive 94/55/EC on the approximation of the laws of the Member States with regard to the transport of dangerous goods by road (Text with EEA relevance)
- Directive 2004/54/EC of the European Parliament and of the Council of 29 April 2004 on minimum safety requirements for tunnels in the Trans-European Road Network.

The current EU classification and labelling system for chemicals is set out in three key instruments:

- “Dangerous Substances Directive” Council Directive 67/548/EEC of 27 June 1967 on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances
- “Dangerous Preparations Directive” Directive 1999/45/EC of the European Parliament and of the Council of 31 May 1999 concerning the approximation of the laws, regulations and

administrative provisions of the Member States relating to the classification, packaging and labelling of dangerous preparations

- “Safety Data Sheet Directive“: Commission Directive 91/155/EEC of 5 March 1991 defining and laying down the detailed arrangements for the system of specific information relating to dangerous preparations in implementation of Article 10 of Directive 88/379/EEC
- Commission Directive 2001/58/EC of 27 July 2001 amending for the second time Directive 91/155/EEC defining and laying down the detailed arrangements for the system of specific information relating to dangerous preparations in implementation of Article 14 of European Parliament and Council Directive 1999/45/EC and relating to dangerous substances in implementation of Article 27 of Council Directive 67/548/EEC (safety data sheets) (Text with EEA relevance).

The following EU Regulations are of relevance with respect to drivers working and rest hours:

- Council Regulation (EEC) No 3820/85 of 20 December 1985 on the harmonisation of certain social legislation relating to road transport
- Regulation (EC) No 561/2006 of the European Parliament and of the Council of 15 March 2006 on the harmonisation of certain social legislation relating to road transport and amending Council Regulations (EEC) No 3821/85 and (EC) No 2135/98 and repealing Council Regulation (EEC) No 3820/85

### 5.4.3 National Regulations

Based on the ADR and EU-Regulations, the EU-Member states and countries which signed the AETR have introduced additional regulations.

#### Germany:

In Germany the following law and regulations are applicable for the Transport of Dangerous Goods:

- Law about carriage of dangerous goods ([Gesetz über die Beförderung gefährlicher Güter \(GGBefG\)](#))
- Regulation about carriage of dangerous goods road / rail ([Gefahrgutverordnung Straße/Eisenbahn \(GGVSE\)](#))
- [GGVSE-Durchführungsrichtlinie \(RSE\)](#)
- [Verordnung über Ausnahmen von den Vorschriften über die Beförderung gefährlicher Güter \(GGAV\)](#)
- [Gefahrgutbeauftragtenverordnung \(GbV\)](#)
- [Verordnung über die Prüfung von Gefahrgutbeauftragten \(PO Gb\)](#)
- [Verordnung über die Kontrolle von Gefahrguttransporten auf der Straße und in den Unternehmen \(GGKontrollV\)](#)
- [Kostenverordnung der Maßnahmen bei der Beförderung gefährlicher Güter \(GGKostV\)](#)
- [Europäisches Übereinkommen über die internationale Beförderung gefährlicher Güter auf der Straße - ADR](#)
- Beförderung gefährlicher Güter im Seeverkehr [IMDG-Code, Ausgabe 2004](#).

[<http://www.verkehrsportal.de/board/index.php?showtopic=36571>]

## Switzerland:

In Switzerland the following Law and Regulations are applicable for the Transport of Dangerous Goods:

### *Law:*

- Law about roads and traffic (Strassenverkehrsgesetz vom 19. Dezember 1958 (SVG))
- Law about public transport (Bundesgesetz vom 4. Oktober 1985 über den Transport im öffentlichen Verkehr (Transportgesetz, TG)).

### *Regulations:*

- European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR); ([\*Europäisches Übereinkommen über die internationale Beförderung gefährlicher Güter auf der Strasse \(ADR\)\*](#))
- Regulation about the carriage of dangerous goods by road (Verordnung vom 29. November 2002 über die Beförderung gefährlicher Güter auf der Strasse (SDR))
- Regulation about experts with respect to transport of dangerous goods by road, rail and waterways (Verordnung vom 15. Juni 2001 über Gefahrgutbeauftragte für die Beförderung gefährlicher Güter auf Strasse, Schiene und Gewässern (Gefahrgutbeauftragtenverordnung, GGBV)).

## 5.5 Additional information

### 5.5.1 WEB Links

Links of WEB-sites of governmental organisations or stakeholders with information about Tracking and Tracing of Dangerous Goods (TDDG):

URL	Organisation / Country	Remarks
<a href="http://www.unece.org/trans/danger/publi/unrec/12_e.html">http://www.unece.org/trans/danger/publi/unrec/12_e.html</a>	UN Recommendations on the Transport of Dangerous Goods. Model Regulations	-
<a href="http://www.hse.gov.uk/cdg/index.htm">http://www.hse.gov.uk/cdg/index.htm</a>	Health and Safety Executive UK	Governmental
<a href="http://www.tc.gc.ca/tdg/menu.htm">http://www.tc.gc.ca/tdg/menu.htm</a>	Transport Canada, Dangerous Goods Canada	Governmental
<a href="http://www.astra.admin.ch/themen/schwerverkehr/index.html?lang=de">http://www.astra.admin.ch/themen/schwerverkehr/index.html?lang=de</a>	Federal Roads Office (FEDRO) Switzerland	Governmental In German and French only
<a href="http://www.dotars.gov.au/transport/australia/dangerous/index.aspx">http://www.dotars.gov.au/transport/australia/dangerous/index.aspx</a>	Australian Government Department of Transport and Regional Services	Governmental
<a href="http://www.epa.nsw.gov.au/envirom/respcsignors.htm">http://www.epa.nsw.gov.au/envirom/respcsignors.htm</a>	Department of Environment and Conservation New South Wales, Australia	Governmental
<a href="http://www.piarc.org/en/">http://www.piarc.org/en/</a>	World Road Association	-

Links of WEB-sites of EU or national Research projects about Tracking and Tracing of Dangerous Goods (TDDG):

URL	Authority / Country	Remarks
<a href="http://www.ymparisto.fi/default.asp?contentid=89673&amp;lan=fi">http://www.ymparisto.fi/default.asp?contentid=89673&amp;lan=fi</a>	TradGIS research project funding through European Commission (EC)	In Finnish only
<a href="http://www.mitraproject.info">http://www.mitraproject.info</a>	MITRA research project funding through European Commission (EC)	In English
<a href="http://www.goodroute-eu.org">http://www.goodroute-eu.org</a>	GOODroute research project funding through European Commission (EC)	In English
<a href="http://www.ertico.com/en/activities/efficiency_environment/sister.htm">http://www.ertico.com/en/activities/efficiency_environment/sister.htm</a>	SISTER research project funding through the EC DG Enterprise and Industry.	In English and German
<a href="http://www.its-austria.info/uploads/tx_userprojekte/project_description_emoges.pdf">http://www.its-austria.info/uploads/tx_userprojekte/project_description_emoges.pdf</a>	EGMOS research project, part of ARTIST programme (Austrian Radionavigation Technology and Integrated Satnav services and products Testbed)	In English
<a href="http://www.transport-era.net/">http://www.transport-era.net/</a>	ERA-NET TRANSPORT (ENT) is a sustainable network of national transport research programmes in Europe.	Partners all over Europe (govt., academic, commercial)

### 5.5.2 More details about ADR

The European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) was signed at Geneva on 30 September 1957 under the auspices of the United Nations Economic Commission for Europe, and it entered into force on 29 January 1968. The Agreement itself was amended by the Protocol amending article 14 (3) made at New York on 21 August 1975, which entered into force on 19 April 1985.

The Agreement itself is short and simple. The key article is the second, which states that, apart from some excessively dangerous goods, other dangerous goods may be carried internationally in road vehicles subject to compliance with:

- the conditions laid down in Annex A for the goods in question, in particular as regards their packaging and labelling; and
- the conditions laid down in Annex B, in particular as regards the construction, equipment and operation of the vehicle carrying the goods in question.

Annexes A and B have been regularly amended and updated since the entry into force of ADR. The last amendments were entered into force on 1 January 2007, and consequently, a revised consolidated version was published as document ECE/TRANS/185, Vol.I and II ("ADR 2007").

The structure is consistent with that of the United Nations Recommendations on the Transport of Dangerous Goods, Model Regulations, the International Maritime Dangerous Goods Code (of the International Maritime Organization), the Technical Instructions for the Safe Transport of Dangerous Goods by Air (of the International Civil Aviation Organization) and the Regulations concerning the International Carriage of Dangerous Goods by Rail (of the Intergovernmental Organisation for International Carriage by Rail). The lay-out is as follows:

Annex A: General provisions and provisions concerning dangerous articles and substances

- Part 1 General provisions
- Part 2 Classification
- Part 3 Dangerous goods list, special provisions and exemptions related to dangerous goods packed in limited quantities
- Part 4 Packing and tank provisions
- Part 5 Consignment procedures
- Part 6 Requirements for the construction and testing of packaging, intermediate bulk containers (IBCs), large packaging and tanks
- Part 7 Provisions concerning the conditions of carriage, loading, unloading and handling.

Annex B: Provisions concerning transport equipment and transport operations

- Part 8 Requirements for vehicle crews, equipment, operation and documentation
- Part 9 Requirements concerning the construction and approval of vehicles.

Applicability of ADR 2007 and limits of validity of previous editions published by the United Nations.

Notwithstanding the transitional measures provided for in ADR 2007, which allow compliance with certain requirements contained in previous editions, the editions of ADR published by the United Nations which may be used for compliance are as follows:

Until 30 June 2007: 2005 edition (ECE/TRANS/175, Vol. I and II and Corrigenda 1-3); as from 1 January 2007: 2007 edition (ECE/TRANS/185, Vol. I and II).

[http://www.unece.org/trans/danger/publi/adr/adr\\_e.html](http://www.unece.org/trans/danger/publi/adr/adr_e.html)

## 6 European Electronic Toll Service (EETS)

### 6.1 Background

#### 6.1.1 European policy

For more than ten years the European Commission has been promoting interoperability of the European road charging systems. The activities are fuelled by one of the core principles of the European Union: the free movement of goods and services. By progressing interoperability, the Commission anticipates the removal of one potential obstacle to trans-European goods transport.

In more recent years a second motive has become important: the policy to develop an Intelligent Transport Services industry in Europe. The policy is driven by the vision to improve the fluency and effectiveness of road traffic and transport through the use of modern telematics technologies, especially satellite localisation (GALILEO).

The EC has pursued the two policy objectives of developing EFC interoperability and of developing an ITS industry initially through sponsoring European research projects and more recently through the framework of an Interoperability Directive.

Additionally, and especially for heavy vehicles, the need to offer a single harmonised technical access to all charging systems currently deployed in Europe has become obvious (Figure 39). Several charging systems for heavy vehicles have been deployed in recent years, all working from different charging principles, policy objectives and technologies.



**Figure 39: For heavy vehicles interoperability of charging systems becomes a necessity**

Picture taken from of truck at Swiss/German border with the following equipment on the windscreen: (from left to right): navigation system, Austrian DSRC-based OBU, Swiss Tachograph-based OBU, German GPS-based OBU

### 6.1.2 Many different fee collection systems

Europe has a long tradition of fee collection on its road infrastructure. In recent years electronic means have been introduced in order to offer more convenience to the user. Most countries with tolled infrastructure now offer an option for electronic fee collection (EFC).

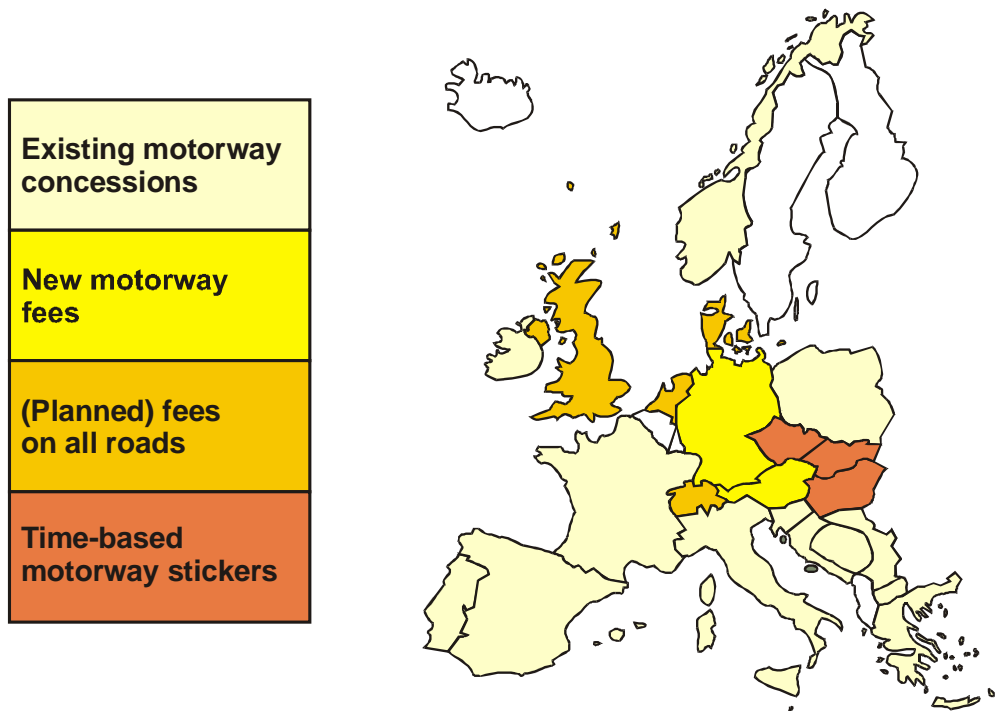


Figure 40: Fee collection systems in Europe

Figure 40 gives an impression of which countries employ which type of system. This does not account for the full diversity, though. The systems are different in many dimensions.

#### 6.1.2.1 Differences in Charging Concept

**Time dependent motorway fees:** In several countries one has to buy a permit, usually a paper sticker (vignette [examples shown in Figure 41]), in order to be allowed to use the motorways. The permits are valid for a certain time, often for a year or part- year.

Examples	Austria	Motorway Vignette (1 year, 2 months, and 10 days) for all vehicles below 3.5 t
	Czech Republic	Motorway Vignette (1 year, 1 month, and 10 days) for all vehicles below 12 t
	Slovakia	Motorway Vignette (1 year and 15 days) for all vehicles
	Hungary	Motorway Vignette (1 year, 1 month, and 9 days) for all vehicles
	Switzerland	Motorway Vignette (1 year only) for all vehicles below 3.5 t





Figure 41: Examples of vignettes across Europe

**Motorway and other infrastructure tolls:** Costly infrastructure is often financed through tolls. For example, motorways in southern Europe operated by private concession companies that finance themselves through tolls that depend on the distance driven on their motorway concession. Also other major infrastructure, like bridges and tunnels, is tolled.

Examples	Austria	The national motorway operator, ASFINAG, started tolling vehicles >3.5 t for the use of motorways in January 2004 (Figure 42)
	Denmark	The large bridges over the Great Belt and over the Oresund are re-financed with tolls (Figure 43)
	France	Most motorways are operated and tolled by concessionaires (around 10 concession companies). Similar situation in Italy, Spain, and Portugal
	Germany	Since January 2005 the German Federation tolls vehicles >12 t on motorways
	Norway	A large number of tunnels and bridges required along the coastline are financed with tolls.



Figure 42: Tolled Austrian motorways



Figure 43: Tolled Øresund bridge in Denmark

**Distance charging:** Distance charging means that all distance covered in a country is charged, regardless of the type of road. This is a rather new concept of fee collection that does not aim at re-financing some special infrastructure, but responds to demand management objectives. By comparison, this type of fee is more a tax than a toll and is usually operated by a state authority.

Examples	Switzerland	Since January 2001, heavy vehicles >3.5 t pay a distance dependent fee on all Swiss roads. The system is operated by Swiss Customs.
	The Netherlands	In the Netherlands a distance-dependent fee for all vehicles on all roads is under preparation by the Ministry of Transport, Public Works and Water Management.
	Sweden	The Swedish Government is planning the introduction of a fee for heavy vehicles for all distance driven on Swedish roads. The project is in an early planning phase

**Access fees:** Access fees have recently become attractive as a demand management tool for authorities managing the ever increasing city traffic. Under this concept, a user has to pay a fee in case he wants to access a certain area, say the inner city. Access fees are especially useful to reduce congestion in otherwise difficult to manage areas or at certain times (time dependent access fee[Figure 44]).

Examples	Italy	Several cities (Rome, Turin, Bologna, Siena ...) have access restricted inner city areas (Limited Traffic Zones, LTZ), partly with fees for the access rights.
	London	Since February 2003 all vehicles except for buses and taxis have to pay a fee when inside a certain cordon between 7am and 6:00pm.



Figure 44: Central London congestion charging sign

**6.1.2.2 Differences in Classification and in Tariff Structure**

The different European countries use different definitions of which vehicles are subject to the fee and also use totally different definitions of which vehicle belongs to which tariff class (Figure 45). For example, a minibus might well be a passenger car in one country, a small bus in the next country, and a 2-axle heavy vehicle in the next.

The classification criteria also differ. Some countries have classification schemes according to size (mostly length classes), some countries according to numbers of axles, others according to vehicle type according to the vehicle licence documents, and yet others have a classification scheme based on licensed weight (maximum permissible total vehicle weight). Some countries include environmental characteristics, like the EURO emission classes, in their classification scheme.

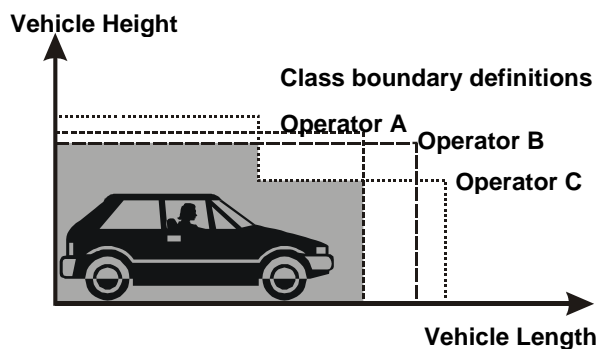


Figure 45: Different operators use totally different vehicle class definitions

**6.1.2.3 Differences in EFC Technology**

Some years ago most operators had already begun offering their customers the option to pay more conveniently through the use of EFC on-board units. Different technologies are employed:

Examples	CEN 5.8 GHz DSRC	This European short-range communications standard is used by a majority of European toll motorway operators, e.g. in the French TIS system, the Norwegian Autopass, the Czech Premid System or the Austrian LKW-Maut.
	Telepass 5.8 GHz DSRC	The Italian operators were among the first to offer an EFC service to their customers. For this purpose they have developed a short range communications technology which is now an Italian national standard but not recognised outside Italy.
	Legacy DSRC	Some companies in Europe still have first generation legacy systems that were installed before standards were available, e.g. low-data rate 5.8 GHz systems (Portugal), 2.45 GHz Tags (Slovenia), 470 MHz Tags, and the like.
	GPS / GSM	Germany is collecting its heavy vehicles motorway toll with the help of OBUs that employ GPS satellite localisation and GSM/GPRS wide area communication technology.
	Licence plate	The Brenner motorway in Austria and the London congestion charging scheme both offer an EFC service based on automatic licence plate reading.

## 6.2 Levels of interoperability

The differences between charging systems as outlined above are just obvious examples. In addition, there are wide ranging differences regarding the charging policy, the legal and institutional environment in which they operate, in the payment means that are accepted, in the charging levels, etc. Obviously, with all these differences, it is an extraordinarily difficult task to make the systems interoperable.

Interoperability was formally defined as the ability of different systems to exchange services with other systems. More practically, and with respect to EFC, this in essence means that a user shall be able to pay in several charging systems with only “only one OBU and only one contract”.

Usually three levels of interoperability are distinguished. There is a hierarchy among them, where the higher levels of interoperability can only be achieved when the lower levels are in place.

### 6.2.1 Technical Interoperability

Technical interoperation is achieved when the same technologies are used and the technical interfaces are realised in a compatible way. This is the arena for standardisation.

In Europe, over recent years, the short-range communication devices operating in the 5.8 GHz frequency band have been standardised in CEN, the European standardisation body. The set comprises four standards.

CEN standards for DSRC systems



Standard	Short title	Contents
EN 12 253	DSRC Layer 1	Specifies the microwave link itself, i.e. frequency, data rate, modulation, etc.
EN 12 795	DSRC Layer 2	Specifies link control, i.e. data frame format, medium allocation, handshake, etc.
EN 12 834	DSRC Layer 7	Specifies basic application aspects, like how to initialise communication, gives basic commands that can be executed over the link (Read, Write), etc.
EN 13 372	DSRC Profiles	Bundles certain parameter settings of Layers 1, 2, and 7 into coherent communication profiles.

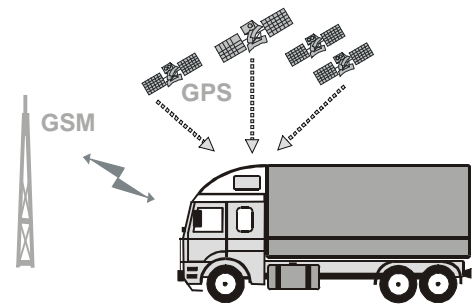
In addition to these basic radio link standards, there is also a standard on the EFC application itself.

EN ISO 14 906	EFC AID	"Application Interface Definition for EFC", specifying in detail the data and commands required for EFC
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For the requirements of interoperability the above standard offers too much flexibility. Hence a standard has been prepared that narrowly defines a DSRC application for European interoperability.

EN ISO 15 509	EFC IAP	"Interoperability Application Profile", restricting the options of the other standards for the purpose of interoperability
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CEN and ISO standards for GPS/GSM systems



There is also a standard in preparation for the other major technical approach to EFC, namely GPS/GSM. Since both the GPS and the GSM/GPRS technologies themselves are already standardised, there is no additional specification required for the base technologies. (With DSRC the situation is different since, as the abbreviation DSRC implies, it is a Dedicated Short Range Communication technology; DSRC is not designed for general purposes, but dedicated and optimised for sole use in the RTTT, Road Transport and Traffic Telematics, environment.).

Hence, GPS/GSM systems require no basic technology standard, but only an EFC application standard (i.e. a standard that specifies for GPS/GSM systems what the EN 14906 EFC AID does for DSRC-based systems). This standard is currently under preparation:

ENV ISO 17575	EFC-API definitions for CN/GNSS based EFC
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This standard has a long history and has been re-drafted several times. Currently it comes in five separate documents in order to allow a phased preparation and voting process. Since there is no common understanding of a GPS/GSM charging system architecture, aspects of the standard are heavily disputed.

**Further supporting CEN and ISO standards**

In addition to the above standards, there are several supporting standards, such as a standard on EFC systems architecture (CEN ISO TS 17573), a standard on an EFC security framework (CEN ISO TS 17574), test standards (e.g. ENV ISO 14907-1 and -2), and a standard about data exchange among operators (EN 14 904).

In summary, on a technical level the foundations for interoperability are laid. Standards for DSRC are available, proven and mature. For GPS/GSM systems, standards are rapidly evolving. For new systems, there is no technical reason why they should not be interoperable with each other. For legacy systems, individual solutions and migration strategies have to be found.

### 6.2.2 Procedural Interoperability

When the technical problems towards interoperation are solved, even larger obstacles remain because of the huge differences in the principles of tariffication. The most striking differences become obvious when one compares the tariff classes in the different countries. Whereas one country charges according to number of vehicle axles, the other one charges according to vehicle type (personal car, commercial vehicle, truck, trailer, etc.) and the next one according to gross vehicle weight. Harmonising these differences is not a matter of technology, but rather one of harmonising approaches or procedures.

Several research projects, all of them co-funded by the European Commission, have tackled these problems (CASH, MOVE-it, VASCO, A1, CESARE, CARDME, to name but a few). The latest of these projects were CESARE, a project of EFC operators focusing mostly on contractual matters, and CARDME (Figure 46), a concerted action of representatives of European countries, with a supporting research group. It is generally recognised that as a result of these two projects, the topic of pan-European interoperability is mature enough for agreements to be achieved between national systems.

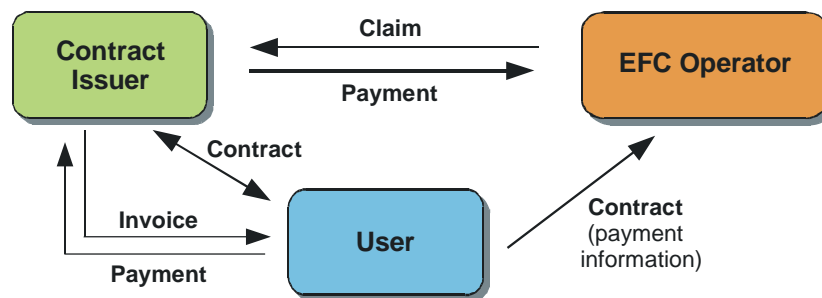


Figure 46: Basic concept of CARDME for the relation between players in an EFC system

Aspects of Procedural Interoperability that have been addressed are:

- tariff models and tariffication principles
- vehicle classification
- exception handling and enforcement
- privacy issues and regulations
- security framework (security policy, security services, security procedures, monitoring, etc.)
- responsibilities (who is responsible for what in legal and/or financial terms).

### 6.2.3 Contractual Interoperability

#### National interoperability

In the last five years the achievements of standardisation and a better understanding of the issues of contractual interoperability have been used to establish interoperability within countries (Figure 47 & Figure 48). Before, even this was by no means guaranteed. However, this first step, namely to accomplish national interoperability, has proved amazingly difficult and time consuming, with abundant obstacles. Most interestingly, harmonising the technological issues was the least complex. It was more difficult to harmonise the approaches of the different toll collecting companies in the procedural and contractual domains. Italy, France, Norway and Spain have completed this task. In all these countries a single national EFC specification has to be obeyed when procuring equipment.



Figure 47: The French motorway concessions are interoperable under the TIS scheme



Figure 48: Toll systems in Norway are interoperable under the AUTOPASS scheme

#### International interoperability

On an international – or even a European – level matters have been more demanding. The national systems have remained fully incompatible for a very long time. However, thanks to the work done in the CARDME and CESARE projects especially, several aspects of contractual interoperability have moved closer to a solution.

Investigations have been carried out into how the institutional aspects could be solved. This mainly covers aspects of *contractual interoperability*, namely to clarify what the roles and responsibilities of the parties involved in interoperable arrangements are, in which contractual framework they best operate, and how exactly to put such agreements in place. A significant hindrance to rapid progress in this area was the common lack of a business case. Interoperability rarely pays. Costs associated with establishing interoperability are comparatively high, even when no legacy system has to be replaced. Just the costs associated with entering a long list of classification data into each individual on-board unit may easily

become prohibitive when compared to the minor benefits an operator can receive from interoperability. In particular CESARE has addressed these issues.

Some initiatives tried to establish bilateral interoperability using these insights, the first being the interoperability between the Swiss LSV A and the Austrian Go-Maut system. None of the initiatives succeeded in establishing contractual interoperability; interoperation remained on a technical and procedural level only. The user was able to travel in two countries with only one piece of equipment, but still had to have separate contracts with the two national systems, and received two separate invoices.

International interoperability has only gained momentum since the European Commission prepared a proposal for a directive on this issue in 2002. The directive was adopted in 2004 and mandates that EFC operators have to provide for interoperable solutions. It has to be recognised that without a certain amount of extra motivation, fee collection operators have little incentive to invest in interoperability. From a commercial point of view, interoperability will rarely be a success. All the benefit lies with the roaming user, and there is little to gain for the operator except user satisfaction and system acceptance.



### 6.3 History of interoperability in Europe

Interoperability of the national electronic fee collection systems in Europe is a goal that has been pursued for many years. For a long time the operators of the national EFC systems have recognised the wish of their customers for interoperability, especially when paying the road usage fees for heavy commercial vehicles used in international haulage.

Historically, several factors have hindered and delayed progress in creating tolling interoperability in a similar way as interoperability of the GSM mobile phone service:

- For several years, **technology was insufficiently standardised**, and parts of the industry had shown little interest in improving the situation since they happily lived in niche markets.
- The nature of the tolls and fees is very different in the individual countries and it has proven to be **close to impossible to harmonise procedures** and operations whilst keeping subsidiarity and leaving every country full freedom to define its tariff structure and tolling system.
- There is **no clear business case** for operators with regards to interoperability. Since toll rates are fixed, an interoperable service does not create additional revenue but may create additional costs.

Over the years, operators have participated in several research and demonstration projects co-financed by the European Union (Move-it, VASCO, A1, INITIATIVE, CESARE, CARDME, PISTA, etc.) in order to achieve interoperability between existing electronic fee collection systems. Only national (Italy, France, Norway, Spain, Portugal, etc.) or bilateral interoperability (Austria-Switzerland) has been achieved up to now. Interoperability on a larger scale, involving more than two countries, is still lacking.

Recently, the situation has markedly improved:

- The 5.8 GHz microwave **DSRC technology is now fully standardised**, including also the application data elements and functions besides the required radio communication stack.
- The multitude of European **research projects has helped to understand the issues** involved in harmonising fee collection procedures and has produced proposals for ways to solve most of the problems.
- Europe has become a true single marketplace and industry heavily relies on the Europe-wide road network for commercial transport. Consequently, commercial tolling customers increasingly demand international interoperability. International interoperability is still commercially not interesting for operators, but **customer satisfaction in itself is a business case for them**.
- In addition, **the European Directive 2004/52/EC** has created a need for tolling operators to develop interoperable solutions. For heavy vehicles, the Directive requires all EFC operators to provide customers with an interoperable EFC service by 2009.

### 6.3.1 European Commission funded research projects

Several research and development projects have been carried out during the last decade on behalf of the European Commission or as private initiatives regarding road user charging. The projects have aimed at different topics, for example:

- pricing and policy strategies
- technical issues
- institutional, legal, procedural and contractual issues

The following are examples of projects and private initiatives which have considered the above matters:

#### **CESARE III (2005 – 2006)**

CESARE III is the third phase of the CESARE programme, which started in 1998. The overall aim of CESARE is to allow road users to make use of their on-board unit (OBU) for payment of road user charges throughout Europe. CESARE III has revised the definition of common charging and/or payment services to be supported, paying particular attention to the definition of the European Electronic Toll Service (EETS). CESARE III has proposed as a main result a mode of actors and responsibilities that is expected to become the cornerstone of the European Electronic Toll Service, EETS.

#### **RCI (2005 – 2008)**

The RCI (Road Charging Interoperability) project aims to develop an open, integrated framework enabling road charging interoperability at the technical (and related procedural) level. It addresses the issue of interoperability of road charging (taxing and tolling) between European countries, trialling and demonstrating interoperability between six key neighbouring countries in which road charging (taxing and tolling) systems already exist: Austria, France, Germany, Italy, Spain and Switzerland.

#### **MLU (2005-2006)**

The MLU (Mobile Location Unit) study addressed the feasibility of installing a common onboard unit in all motor vehicles, and examined its benefits in making possible a wide-range of interoperable functions supporting driver services, traffic management, enforcement, emergency call and road user charging. The aim of the project as stated by DG TREN was “to investigate and define the functionality, constraints, and systems architecture, and to assess the benefits of a telematics platform integrated within the vehicle or as a single core vehicle unit.”

#### **CARDME I-IV (1994 – 2002)**

The CARDME project (Concerted Action for Research on Demand Management in Europe) was established by the European Commission in 1994 to identify and overcome obstacles to the interoperability of EFC systems. Attention in CARDME was to define a common minimum functionality for interoperable EFC systems. The approach adopted avoids trying to get all systems to work together, but requires operators to provide an additional service for those users requiring system interoperability.

### PISTA (2002 – 2004)

The PISTA project (2002-2004) aimed to demonstrate the feasibility of implementing interoperable EFC systems along different toll highway facilities in several countries belonging to the European Union. The project built their work on the results of the concepts defined in previous European projects (VITA, MOVE-IT, CESARE I and CESARE II).

### MISTER (2004)

The main objective of MISTER (Minimum Interoperability Specification for Tolling on European Roads) was the elaboration of a framework for the development of Europe-wide interoperable OBU as well as the specification of technical, functional and operational characteristics of such OBU (Figure 49). The MISTER specification includes systems that are based on wide area communication (CN) only and systems that are based on wide area communication and DSRC. It does not include systems that are based on DSRC only. Central Equipment is not specified. The specification has remained a draft and covers only selected aspects of the wide objectives of the project.

### 6.3.2 Interoperability Initiatives



Figure 49: OBU from different EFC Schemes



Figure 50: MEDIA Countries

### MEDIA (2004 – 2006)

MEDIA stands for Management of EFC DSRC Interoperability in the Alpine Region. It is an interoperability initiative of tolling operators from the Alpine countries: Austria, France, Italy and Slovenia (Figure 50). MEDIA has the objective to find and implement a concrete solution to enable tolls for heavy vehicles in the participating fee collection systems to be paid electronically and in an interoperable way. MEDIA builds on existing foundations and especially uses material from the projects CESARE, PISTA and CARDME. The MEDIA service will be operational from late 2007.

## **NORITS**

NORITS is a joint initiative between road authorities and toll road operators in the Nordic countries. The 4 partners involved in the project are:

- Sund & Belt Holding AS for the Great Belt Link
- The Oeresund Bridge Consortium
- The Swedish National Road Administration for the new Swedish systems (Svinesund, Stockholm)
- The Norwegian Public Roads Administration (NPRA) for the AutoPASS system

NORITS is a service offered to all users of existing toll collection systems in the Scandinavian countries. The service makes it possible for any user to pay the toll fee of any toll collection system in this area with the on-board unit. The NORITS service has been available since spring 2007.

## 6.4 Introduction of the EETS

### 6.4.1 Interoperability Directive

The European Directive 2004/52/EC on “the interoperability of electronic road toll systems in the community” was adopted in April 2004.

The Interoperability Directive covers all types of road fees on the entire Community Road Network; urban and interurban, major and minor roads, and various structures such as tunnels, bridges and ferries. The objective of the Directive is to create a European Electronic Toll Service (EETS) where every user can use all charged networks with a single piece of equipment and with a single contract.

In order to achieve this goal, the technologies used for charging have to be harmonised. Article 2 of the Directive states:

“All new electronic toll systems brought into service on or after 1 January 2007 shall, for carrying out electronic toll transactions, use one or more of the following technologies:

- satellite positioning;
- mobile communications using the GSM GPRS standard;
- 5.8 GHz microwave technology”.

Prescribing only the technologies is not enough. The annex of the Directive lists the further items that need to be harmonised in order to achieve interoperability and to agree on the EETS. All these agreements shall be reached by formal vote in the Comité Télépéage which comprises all Member States of the European Union. Decisions of this Committee are prepared by individual Expert Groups for specific topics (see next chapter).

The Directive requires all large electronic fee collection systems in the Member States to offer an on-board unit to its users that enables them to travel across Europe with only this single on-board unit and with only one service contract. This new interoperable service is complementary to the existing services, which means that local arrangements can remain unchanged, but the user has a new additional option which he can choose to pay his fees.

The Directive clearly describes that interoperability shall NOT be achieved by harmonising the national electronic fee collection systems, but via an on-board unit that works in all the different systems. Naturally, that does not go without some adaptations or additions to the road-side and central systems of the individual countries, for example some central systems might need to be adapted to enable a certain form of international clearing of payments. It is generally assumed that such adaptations will be small and additive, meaning that they shall not change existing situations but rather offer new capabilities.

The Directive sets out a target timetable. The definition of the European Electronic Toll Service (EETS) should have been agreed by 1 July 2006. Member States with electronic fee collection systems are required to introduce the EETS for all vehicles exceeding 3.5 t, and for vehicles carrying more than 9 passengers, within 3 years of agreement on the definition of the EETS (1 July 2009). Member States are required to introduce the EETS for all other vehicles within 5 years of agreement on the definition of the EETS (1 July 2011). These dates have to be postponed since the definition of the EETS appears to have been delayed at least until the end of 2007.

The EFC Directive does not apply to:

- road toll systems with no electronic means of toll collection (e.g. Vignette systems)
- electronic road toll systems which do not require the installation of on-board equipment (e.g. systems based on automatic licence plate reading)
- small, strictly local road toll systems for which the cost of compliance would be disproportionate to the benefits (e.g. local bridge tolls).

The EETS has no impact on the decisions made by Member States to levy tolls on particular vehicles, on the level of charges, or on the purpose for which charges are levied.

## **6.4.2 Process to define the EETS**

### **6.4.2.1 Regulatory Committee**

The Regulatory Committee is a body that has been established by the Interoperability Directive that was adopted in April 2004 (Directive 2004/52/EC). The Directive only defines a basic framework for interoperability of charging systems by defining the technologies that shall be used and by defining a timeframe for the introduction of the EETS. The Directive does not define the details of the EETS. It only lists in an annex the issues that need to be agreed, harmonised and defined before the EETS can be established.

For the definition of the details of the EETS, the Directive sets up a Regulatory Committee, called Comité Télépéage. This Committee consists of representatives nominated by each of the Member States of the European Union. All the detailed agreements required for establishing the EETS shall be reached by formal vote in the Regulatory Committee. If agreements can be reached in the Committee, they become new Annexes to the Directive.

The European Commission convened preparatory meetings in June 2003 and January 2004, to which all Member States were invited, including the accession EU countries. Representatives of various European associations, such as ASECAP and IRF were also invited. These preparatory meetings took no decisions and had no formal status. Following the publication of the Directive, the first formal meeting of the Comité Télépéage was held in June 2004. Meetings are held about twice a year.

During the preparatory meetings it became apparent that the Comité Télépéage as a voting body is not a good platform for developing detailed solutions. In addition, major stakeholders such as the candidate countries, EFTA countries, EFC operators and ITS industry are not represented. Hence, the European Commission has established two additional groups:

- the EFC Expert Group for preparing the agreements to be voted on in the Comité Télépéage
- the Road Platform as a platform for discussion with industry .

The EFC Expert Group comprises the Member States, the candidate countries, the EFTA countries (NO, CH, IS) and some relevant associations (ASECAP, IRU, ERIC, IRF, ACEA). The EFC Expert Group meets about four times per year and discusses various details required for the EETS. The topics that are discussed are prepared by small Expert Groups of five to ten specialists in the field, are discussed in the next section.

In summary, the decision making process of the EETS definition can be displayed as illustrated in Figure 51:

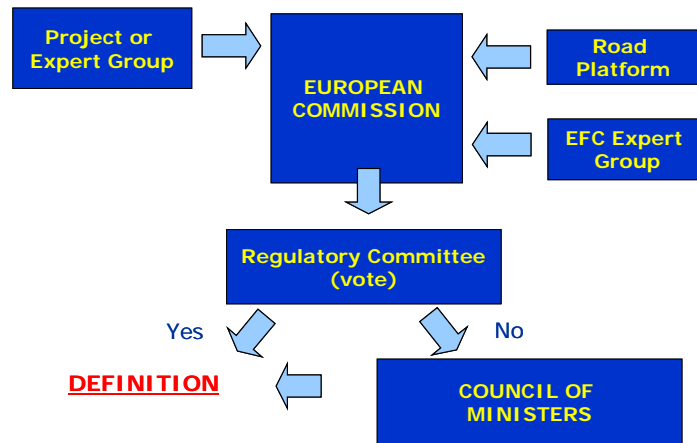


Figure 51: The process for defining the EETS

#### 6.4.2.2 Expert Groups

Topics that are discussed at the EFC Expert Group are prepared by small Expert Groups. These Expert Groups are set up and paid by the Commission and also report to the Commission. The Commission takes the input and prepares on that basis reports that are discussed at the (large) meetings of the EFC Expert Group.

Members of the Expert Groups are selected by the Commission from a pool of experts. Experts that are selected to become member of an Expert Group receive a contract from the Commission for a limited number of days and with a detailed working scope.

The following Expert Groups (EG) have been working:

#### EG 1 Microwave technologies led by Jesper Engdahl (Rapp Trans, Switzerland)

The Directive lists “5.8 GHz microwave technology” as one of the supported technologies of the EETS. Two main 5.8 GHz technology implementations exist, namely the CEN TC278 standard DSRC used in nearly all European countries, and the Italian Telepass DSRC. Expert Group 1 was tasked to make recommendations as to which technologies shall be supported in the EETS and how interoperability among these shall be achieved. The report gave the recommendation to support both CEN and Telepass microwave technologies. This proposal has been heavily disputed and the issue will only be settled by voting in the Comité Télépage.

#### EG 2 Classification of vehicles led by Ken Perrett (Rapp Trans, UK)

This group has proposed a harmonised scheme of vehicle classification for the EETS. In the EETS, tariffs for vehicles shall be defined based on a set of harmonised characteristics that are available in every EETS on-board unit. The proposed set of characteristics has been designed to be both minimal in order to reduce complexity and of sufficient information content in order to support a maximum of conceivable charging policies. The proposal was finalised in February

2005 and was supported in the EFC Expert Group. A positive vote by the Comité Télépéage is expected.

**EG 3 Enforcement of offences** led by Jean Mesqui (ASFA, France)

This group looked into requirements of the EETS regarding enforcement in an international context. The group found that most enforcement problems have to be solved on a national level and made some recommendations for European actions.

**EG 4 Certification centres** led by Francisco Soriano (LISITT, Spain)

Expert Group 4 has analysed scenarios for a network of certification centres to certify equipment for EETS compliance. The group has recommended two types of centres, namely for approval of EETS compliant on-board equipment and for approval of application software. The report has led to the Commission letting a contract to a certification body (TÜV Rheinland of Germany) to further develop the concept of a European-wide network of certification centres.

**EG 5 GNSS/CN technologies** led by Wolfgang Beier (Toll Collect, Germany)

Expert Group 5 has created a list of open issues regarding tolling with satellite technology and cellular network communications and has recommended some actions to tackle these issues.

**EG6 Integration of OBUs in vehicles** led by Mike Hollingsworth (ACEA, Brussels)

This group has established recommendations for OBU design to enable a good integration into vehicles. It has no impact on decisions to be taken by the Comité Télépéage.

**EG7 The role of the financial institutions** led by Klaus Philipp (AGES, Germany)

The report has addressed mostly contractual issues related to the payment process. Its recommendations were taken up by the CESARE project and will enter Commission decisions by clarifying the roles of the involved actors.

**EG8 Verification of the Telepass specification** led by Jesper Engdahl (Rapp Trans, Switzerland)

This group was a follow-up to Expert Group 1 and validated some technical detail of the Italian Telepass DSRC specification in order to make sure that an open supplier market is established.

**EG9 Specifications for a pan-European satellite EFC system** led by Ian Catling (ICC, UK)

This group is a follow-up of Expert Group 5 and looked at architecture options for the satellite part of the EETS. The group did propose a reference architecture, but this recommendation is heavily discussed by industry that supports different OBE concepts. The main issue here is whether the EETS will be edge-heavy (“thick client solution”) or centre-heavy (“thin client solution”). Different manufacturers follow different concepts and the discussion has some aspects of a religious war.



**EG10 Technologies and specification for enforcement** led by Joao Pecegueiro (Via Verde, Portugal)

Expert Group 10 has investigated technical issues of enforcement and the potential impacts on the EETS, such as the need for a harmonised enforcement interface. The group is a follow-up of Expert Group 5 and has defined several detailed recommendations for enforcement equipment. Its impact on regulatory decisions is expected to be small.

**EG11 Specification of a pan-European EFC application on microwaves** led by Bernhard Oehry (Rapp Trans, Switzerland)

This group was tasked to produce a single harmonised DSRC transaction specification, including data, functions, and security, for the DSRC part of the EETS. The developed specification was well received by the EFC Expert Group and is already now widely seen as the basis of the EETS for DSRC. Its recommendations have been formalised in a European standard, EN 15509. This standard defines the technical requirements for interoperability of DSRC systems in the EETS.

**EG12 Security aspects of the EETS** led by Stefan Eisses (Rapp Trans NL, Netherlands)

Expert Group 12 was tasked to look into system-wide aspects of security for the EETS. It has analysed threats and countermeasures and given concrete recommendations for establishing trust among the parties involved. Its recommendations are mostly on a technical level, but some organisational aspects will have an influence on regulatory decisions.

**6.4.2.3 Road Platform**

The Road Platform has been jointly established by the Commission and by ASECAP (refer section below). It is an open meeting where issues of the Directive, especially reports of the Expert Groups, are discussed with stakeholders such as the ITS industry, the EFC operators, various associations and other interested parties. Meetings of the Road Platform are held about twice a year in Brussels.

**6.4.2.4 ASECAP**

ASECAP is the European association of toll road concession holders. Most European toll motorway, bridge and tunnel operators are members of ASECAP. ASECAP has an office in Brussels to represent the interests of the private toll road operators in front of the European Commission.

ASECAP is very active regarding interoperability, especially regarding DSRC systems. For example, the important project CESARE on contractual interoperability is led by ASECAP and supported by several ASECAP members.

#### 6.4.2.5 Stockholm Group

Stockholm Group is an informal grouping of Member States. It was formed following a discussion of interoperability issues facing European governments at the ITS World Congress in Sydney in 2001 and takes its name from the venue of the first meeting. The Group meets periodically to share developments and to seek agreement on interoperability issues relating to charging for road use. It also sets up workshops to tackle specific issues in detail, such as “Understanding the Directive” or “Architectures for Interoperability”.

The Group is chaired by Jan W. Tierolf from Rijkswaterstaat in the Netherlands. The countries involved are:

Austria	Finland
Germany	Netherlands
Poland	Slovenia
Sweden	Switzerland
UK	

Except for Austria, none of these countries are members of ASECAP.

Stockholm Group is a useful forum for member states with schemes that are not based on a concession model but on governmental, taxation-related charges, be they already operational or in a planning or exploration stage. Stockholm Group provides for a stronger voice at the Regulatory Committee for the complex issues of countries with advanced charging policies that go beyond mere financing of infrastructure.

#### 6.4.3 Results achieved

The process for the introduction of the EETS is progressing differently on different fronts.

##### 6.4.3.1 Technical specifications

Regarding the DSRC, the technical specifications are finalised with the adoption of the standard EN 15509 for an “Interoperability Application Profile” in early 2007. The foundation for this success was laid especially by Expert Group 11 that has achieved wide political support from Member States in the EFC Expert Group. Regarding the special situation of Italy, matters are not yet resolved since no formal decision has been taken yet, (see below).

For GPS/GSM-based systems the development of standards has proven to be a complex and large task. The relevant document, EN 17575, is still in a relatively early draft stage. In particular, some aspects of architecture have lead to a fight between the manufacturers supporting the development of the standard. There is an ongoing dispute, with some strong beliefs and subsequent arguments, especially on aspects of architecture.

#### 6.4.3.2 Procedural and contractual aspects / EETS role model

A major step forward has been the outcome of the project CESARE III, discussed in the EFC Expert Group in January 2007. CESARE III has proposed a reference model for the EETS on an abstract level that is simple in appearance but has deep implications for the definition of the EETS (Figure 52). The CESARE model is already widely accepted and is used by all European parties as the reference architecture for the relationship between entities.

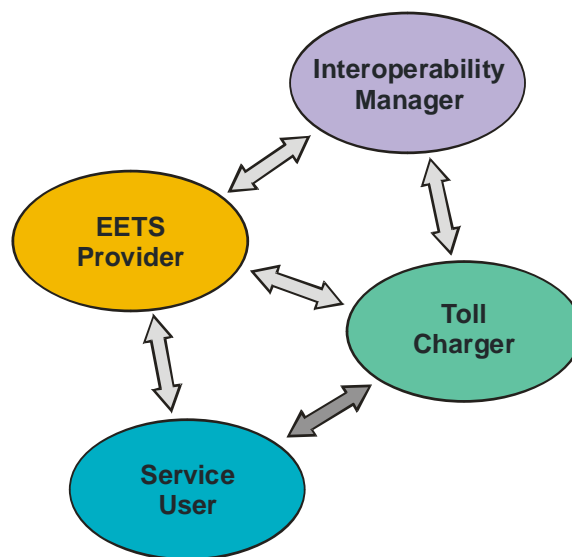


Figure 52: Role model for the EETS proposed by CESARE III

In reality one organisation may have two or more roles. For instance, very often the same organisation, e.g. a toll collection company, may cover all the different roles in the Provision of the EETS as well as the Charging of the Toll.

The roles in the CESARE model cover several actors:

- the **Service User** contains the driver, the haulier, and the vehicle owner
- the **Toll Charger** contains the EFC operator and the transport service provider
- the **EETS Provider** contains the contract Issuer and the payment means provider
- the **Interoperability Management** contains laws and regulations, the EFC Expert Group, standardisation, framework agreements, and the management of system-wide identifiers and security keys.

The roles in the CESARE model have to fulfil defined responsibilities:

#### EETS Provider

- providing the OBU and initialising the OBU in a secure way
- maintaining the functionality of the OBU
- providing and managing the EETS contract including the service rights for the service user
- guaranteeing that the Toll Charger will be paid for the service provided
- providing the payment means or accepting an existing one

- collecting the money from the Service User
- managing the customer relationships concerning information, claims, questions and answers, error handling and any contractual or financial matters
- implementing and adhering to the security and privacy policies for the EETS system.

**Toll Charger**

- providing the transport service, e.g. access to a road network, a parking lot or a ferry
- defining the charging principles for the service offered, e.g. the tariffing principles
- operating the charging point
- detecting, recording and handling exceptions (including fraud) whenever a vehicle passes
- handling enforcement cases
- implementing and adhering to the security and privacy policies for the EETS system.

**Service User**

- driving the vehicle subject to fee including:
  - interacting with the OBU, e.g. declaring the vehicle characteristics for the vehicle subject to fee or receiving messages and acting on the messages from the OBE
  - receiving messages from the EETS system, e.g. a signal or a sign in a toll station
- signing a contract with the EETS Provider regarding the payment means and regarding the rights and obligations for using the EETS Service
- acquiring an OBU and installing the OBU in the vehicle
- receiving the claim, e.g. by means of an invoice, for a service that has been used
- paying the fee included in the claim.

**EETS Management**

There is a need for overall management of the EETS system which includes defining and organising the policy that enables the daily operation of the EETS system involving several different actors.

The responsibility of the EETS Management is to define and maintain a Set of Rules:

- commercial rules (business rules)
- functional rules
- technical rules.

The Set of Rules will as a minimum define the following responsibilities:

- defining the security and privacy policies for the EETS system
- defining the certification requirements for actors involved and equipment used in the EETS
- defining and maintaining ID-schemes
- defining the operational procedures
- managing disputes.

#### 6.4.3.3 Formalisation in Commission Decisions

The Interoperability Directive gives a framework but does not define details. The European Commission has the task to prepare additional decisions for vote by the Comité Télépage. The decisions are drafted using input from the twelve Expert Groups and from European research projects, especially CESARE III. The drafts are then discussed with the Member States in the EFC Expert Group.

In 2006, three draft Commission decisions were presented and discussed:

- Decision 1 contained some basic definitions, a specification of the supported classification parameters (as recommended by EG2) and the specification for the DSRC transaction of the EETS (as recommended by EG11)
- Decision 2 contained some material regarding GPS/GSM systems
- Decision 3 contained material from the CESARE III project and addressed procedural aspects of the EETS.

Whereas draft Decision 1 was basically accepted by the Member States active in the EFC Expert Group, draft Decisions 2 and 3 received little support. The draft Decisions were also submitted to an internal Commission “inter-service consultation” process and all three drafts failed to get approval.

As of early 2007, the process of preparing the Decisions has to be set onto new foundations. There is an obvious willingness of Member States that are close to specifying and procuring new national charging systems to actively contribute to the drafting process. These Member States fear that unless there is a stable definition of the EETS, their procurements might lead to systems that later turn out to be non-compatible with the European system. Several members of Stockholm Group have undertaken the task of contributing to drafting completely reworked decisions. It is expected that these decisions will come to vote by the end of 2007.

## 6.5 Impact and conclusions

European interoperability of electronic fee collection systems has been a target since the early 1990s. Progress has been incredibly slow despite the large efforts invested in terms of European money in research projects, in standardisation activities and in policy statements.

Slow progress is somewhat counter-intuitive. For the following reasons the informed public and major stakeholders had expected faster progress:

- Interoperability and the free roaming of users in GSM has been a rather fast, both technically and commercially, and successful development. The ability to roam freely throughout Europe, and even worldwide, has become one of the success factors for the mobile phone boom seen in the 1990s. Most people expected a parallel development in EFC.
- DSRC technology is - as the name implies – dedicated to tolling. People expected that such a specifically developed technology with a narrow scope and high standardisation efforts would quickly lead to interoperation.
- “Roaming” users, i.e. mostly international commercial traffic by heavy vehicles, has expressed urgent demand for interoperable solutions on a regular basis. An apparent drive from the market was seen.
- Policy makers, and especially the European Union, have always given high priority to interoperability in their policy statements. This was interpreted as a clear commitment of the major stakeholders.

Despite these favourable circumstances, the goal of “one on-board unit, one contract” has remained a moving target over fifteen years and has always appeared to be within reach in the next two to three years. This is still the case. The following analysis details the reasons for this.

### 6.5.1 Interoperability is difficult

The three aspects of interoperability:

- technical interoperability
- procedural interoperability
- contractual interoperability.

build upon each other. Technical interoperability is the foundation upon which procedural harmonisation can be achieved. Contractual interoperability, including the commercial arrangements between the Toll Chargers and the EETS Service Providers, is the final building block that then puts the whole system into operation.

In the process of working towards interoperability the complexity of the problem was completely underestimated. Every step was more difficult than expected, and considerably more time consuming.

Unfortunately, many people believe the problem of interoperability is mostly a technical one. Only those with long experience in the process understand that basically:

- technical interoperability is comparatively easy to achieve
- procedural interoperability is a very complex problem with no easy solutions
- contractual interoperability is very time consuming to negotiate.

**Technical interoperability** is mostly a matter of standards. It was rather easy and quick to achieve some basic agreements and the technical skeleton of the DSRC communication stack was already completed to a high degree in the early 1990s. Unfortunately, the remaining details took 10 years to be sorted out. Standardisation is a voluntary process organised and resourced mostly by the interested industry. For EFC some industrial players had good reasons not to go for standardisation. If a company managed to win a contract in a large nation-wide EFC system with their bespoke solution, it had a practical monopoly and could enjoy a single-supplier environment for years to come. Consequently some industrial players managed to sabotage the standardisation process for years – with the support of those countries, which have adopted their individual solutions. This deadlock was only broken in the new millennium, when the strategy became too obvious. For a few years now the DSRC communication stack has been fully standardised and provided a sound technical basis for interoperability.

For GPS/GSM systems standardisation started considerably later. Also this process is comparatively slow. There are again some aspects of a fight by industrial partners, but mostly the problem appears to come from a lack of experience. Only one EFC system, namely the German lorry tolling, employs GPS/GSM technology. The Swiss LSVA system also has an OBU that works autonomously, i.e. without support from dedicated roadside equipment, but it uses no GSM communications and uses GPS only as a secondary technology for internal supervision. Accordingly, due to the lack of systems, there is no experience with interoperability. In addition, the experience with GPS/GSM systems is localised to one country. A standard for the GPS/GSM system has been in preparation for almost ten years now (ISO 15575), but progress is slow and it has been completely reworked and restructured several times. Apparently there is no agreed best practice yet, and there are still fundamentally different understandings of which processes should be done in the on-board unit and which ones in the central systems.

**Procedural interoperability** was neglected for a long time, with everybody expecting that the standardisation would solve the problem. It took a long time for people to realise that different EFC systems are fundamentally different. Firstly the legal basis can be very different, with the extremes being a privately collected usage-fee at the one end and a national distance-dependent tax at the other end. In addition, different EFC schemes have different tariff structures, different vehicle classification principles, are with or without value added tax, are operated by entities with different legal status and have different operational principles, for example regarding which data are held on-board and which ones off-board.

There was no fight by stakeholders regarding procedural interoperability, but rather large efforts, mostly by Toll Chargers (who have over the years co-operated in European research projects), to find harmonised approaches to procedural interoperability. The understanding of the problems involved grew over time and, with every new insight, new complexities were popping up. For several years the number of problems identified was growing faster than the number of solutions found. Only with the recent work of the Commission Decision following the Directive, are problems are being resolved.

Building on the pillars of technical and procedural interoperability, **contractual interoperability** was late to start, and again proved to be a completely underestimated problem. To a large extent this is certainly due to a lack of a clear business case, as explained in the next section, but also to the large number of actors involved. The different actors – tolling operators, road operators, authorities, banking institutions, service providers, manufacturers, enforcement agencies, etc. – all have a different legal status and a different scope of activities in different countries. It is by no means clear how to establish commercial arrangements between them that enable a roaming service for the user.

Already the contractual structure is difficult to find. At the extremes, on one hand is a solution that builds on a single Memorandum of Understanding (MoU) that binds all actors together, on the other hand is a

solution based upon an incredible multitude of bilateral contracts. Neither of these basic approaches come without problems. A MoU type of approach suffers from problems of harmonising all the national legal and institutional peculiarities, whilst the bilateral approach is difficult because of the sheer numbers involved: national authorities in about 25 concerned countries, some 300 tolling companies, and probably dozens of companies that want to become EET Service Providers.

With the work of CESARE III and the proposed model and framework, most informed people believe that a solid basis for commercial arrangements has now been found, but practical proof is still lacking. In particular the narrow business case detailed in the next section may leave only small room for attractive contracts.

In summary, when reviewing the past fifteen years of work on interoperability, one can say that the problem is indeed difficult and the long delays encountered in the process can, on the whole, be attributed to the amazing complexity of the problem.

### **6.5.2 Lack of a clear business case for several actors**

In recent years it has become obvious that the business case for interoperability is not clear at all and, in fact, has never been properly investigated. Interoperability was rather seen as a common European political matter, like the introduction of the Euro or the GALILEO satellite system. Also, as presented in the next section, external motives were strong drivers behind the will of some parties to go for interoperable solutions. All in all, none of the actors involved appears to have a strong business case that would result in the commitment and the will to move forward:

- Toll Chargers receive income from tolling irrespective of whether the user uses an interoperable service or pays with one of the locally foreseen means. In principle, interoperability could reduce operational costs somewhat by increasing the number of equipped users, which would create lower operational costs than users using manual payment alternatives. These potential cost savings are offset by the technical adaptations required, and also have to be seen against the background of the small fraction of foreign users at toll plazas. There is only a business case for national interoperability, and this has, in the meantime, been achieved in most countries, notably France, Italy, Spain and Norway.
- Only a few users can benefit from interoperable devices. For the private user, roaming mostly during holidays, the credit card as a universally accepted means of payment already provides for enough interoperation. The user has little need for a fully electronic solution and does not mind stopping now and then in order to present their credit card. For commercial vehicles it has to be acknowledged that most only operate nationally and never leave the country. Only a small fraction of heavy trucks are in international freight (between 10% and 15%), leaving only a small customer base with an interest in interoperability. These customers are indeed expressing a wish to have interoperable equipment. However, it has not been established whether they will be willing to pay substantial roaming fees on top of the tolls.
- For industry delivering tolling equipment, interoperability does not bring obvious benefit. Since only a few users have a strong interest in the equipment, no boom in equipment purchase can be expected when systems become interoperable. On the contrary, when one interoperable box replaces several national ones, there is obviously a smaller market for equipment. The initial excitement that interoperability could spur deployment of telematics devices that will serve several value-added traffic-related services has faded away in recent years for lack of commercially interesting large-scale applications.



- For service companies there would indeed be a new business opportunity when they become EETS Providers. For the reasons given above, the market is comparatively small and the margins likely to be low. As a result, service companies today see interoperable EFC only as an element they need to offer within a complete service, but not as a core business. The first major stakeholders have already reduced their activities in this field.
- Member States hold the flag of interoperability high in their policy statements, but commitment is – at least until recently – rather low. Interoperability was a nice and consensus-oriented issue in policy programmes, but for lack of a clear business case active contribution was lacking. Also the necessary expertise has not been around in the governmental departments concerned. The situation is changing recently, though, since the Interoperability Directive now puts pressure on Member States to comply with the interoperability requirements defined therein. In addition to this, countries that intend to procure new large national tolling systems in the near future are now actively contributing to the process since they have high interests that their new systems are compliant with the EETS in order to protect their planned investments.

All in all, European interoperability has always been high on the agenda, but with little commitment by the concerned stakeholders. Accordingly, progress has been slow and haphazard.

### 6.5.3 Driven by external and unrealistic motives

The topic of international interoperability has only to a small extent been driven by a genuine interest in enabling users to freely roam through Europe and to remove potential barriers to trade, as asked for by the very principle of the European Union.

In fact, activities were mostly fuelled by the following interests:

- **Traffic Telematics as a new business for European industry**  
The European Commission has been driving interoperability in the hope of promoting European industry. Europe should become a leader in traffic telematics, which by many is seen as the next big industrial development arena after the audio-video, computing and mobile telecomm markets have become saturated. Traffic problems are steadily increasing and there is no obvious answer that equally quickly and effectively addresses the problems as does traffic telematics.  
  
While the analysis behind this motivation is probably correct, and it is also not a bad idea to make sure that European industry develops capabilities in the traffic telematics sector, this motive has not helped the case of interoperability. This is because it has led to a focus on technology instead of on procedures, and has also led to solutions being promoted that are not tailored to the problem at hand but are far more complex and capable in order to serve as a platform for more sophisticated telematics service offers.
- **Traffic-related value added services as new business for service providers**  
EFC has widely been seen as the “killer application” that will in its wake carry traffic telematics applications into nearly every vehicle. The argument has been that, since tolling cannot be avoided, people will be forced to have EFC equipment, with these additional services, termed “value added services”, riding piggy-back on the EFC application. The first target for these services has been heavy vehicles.

- **Promotion of the GALILEO satellite localisation system**

The European Union has decided to erect a European alternative to the American GPS satellite localisation system. It was decided that this system of satellites, GALILEO, shall to a large extent be financed through private money. Interest of private investors has been low since there is no obvious source of income to justify the investment. The European Commission then promoted traffic telematics as one of the applications that would create a commercial business case for GALILEO, and in this, tolling would be the lead application. Hence, the European Commission has been driving European interoperability, and especially the acceptance of the Interoperability Directive, in order to promote the use of satellite localisation systems in traffic and transport. This has led to a strong focus on technology and to high pressure for the development of an interoperable framework for GPS-based tolling, even when the only country to be interoperable with is Germany.

Since these motives do not lead to a genuine interest in interoperability itself, motivation by stakeholders was low to tackle the critical (and difficult) aspects. Focus has to a large extent been on aspects of technology, for example, whether GPS/GSM is better than DSRC, or whether edge-heavy is better than edge-light architecture, but little effort has been invested in defining processes, arranging for the proper legal background and investigating suitable commercial arrangement for interoperable service provision.

To a large extent, the slow progress of interoperable solutions for electronic fee collection in Europe can be attributed to “doing the right thing for the wrong reasons”.

## 6.6 Regulatory documents

### 6.6.1 EU Regulations

The following EU Regulations are of relevance with respect to Electronic Fee Collection (EFC):

- Directive 1999/62/EC of the European Parliament and of the Council of 17 June 1999 on the charging of heavy goods vehicles for the use of certain infrastructures
- Directive 2004/52/EC of the European Parliament and of the Council of 29 April 2004 on the interoperability of electronic road toll systems in the Community (Text with EEA relevance)
- Directive 2006/38/EC of the European Parliament and of the Council of 17 May 2006 amending Directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructures.

### 6.6.2 Standardisation

#### ISO

- ENV ISO 17575 - EFC-API definitions for CN/GNSS based EFC  
(Name under revision. To be split into several separate documents, possibly with different numbering).

#### Main CEN standards regarding EFC are:

- EN 12253:2004 - Road transport and traffic telematics - Dedicated short-range communication - Physical layer using microwave at 5.8 GHz
- EN 12795:2003 - Road transport and traffic telematics - Dedicated Short Range Communication (DSRC) - DSRC data link layer: medium access and logical link control,
- EN 12834:2004 - Road transport and traffic telematics - Dedicated Short Range Communication (DSRC) - DSRC application layer
- prEN 15509:2006 - Road transport and traffic telematics — Electronic fee collection — Interoperability application profile for DSRC.

## 7 Alpine Crossing Exchange

### 7.1 Background of Alpine Crossing Exchange

The paths and routes over the European Alpine area have been of major importance for trade between northern/central and southern Europe for millennia. In the last two hundred years, roads and railways have been constructed over and through the Alps in order to cope with the flow of goods and people between these economic areas (Figure 53). However, the traffic has not only brought economic prosperity to the mountainous valleys; the huge volume of traffic has become a problem for the environment. During the years, environmentally friendly, but less competitive, rail transport lost its market share in the transportation of goods to hauliers who use trucks for their transport from and to Italy. In France and Austria, the share of goods transported by rail over the Alps has dropped to a quarter of all transported goods, whereas in Switzerland, two-thirds of goods are still transported by rail.

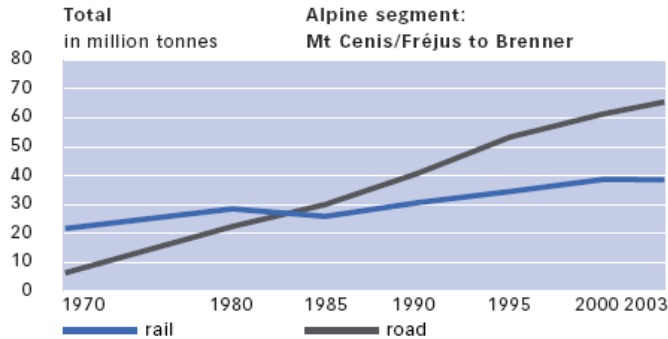


Figure 53: Main alpine crossings

[Source: www.johomaps.com]

Since 1970, the traffic in the EU member states has, in transalpine traffic, almost tripled from 500 to 1500 billion tonne kilometers. A similar increase was observed for goods transport over the Alps. From 30 million ton kilometers in 1970, the amount has increased today to over 100 million ton kilometers (Figure 54). The increase of transported goods and the shift from rail to road transport has led to a significant increase in trucks driving on the Alpine transit roads, leading to a heavy increase in emissions such as pollution and noise, as well as to congestion on the roads.

**Total transalpine goods transport (domestic, import, export and transit)**



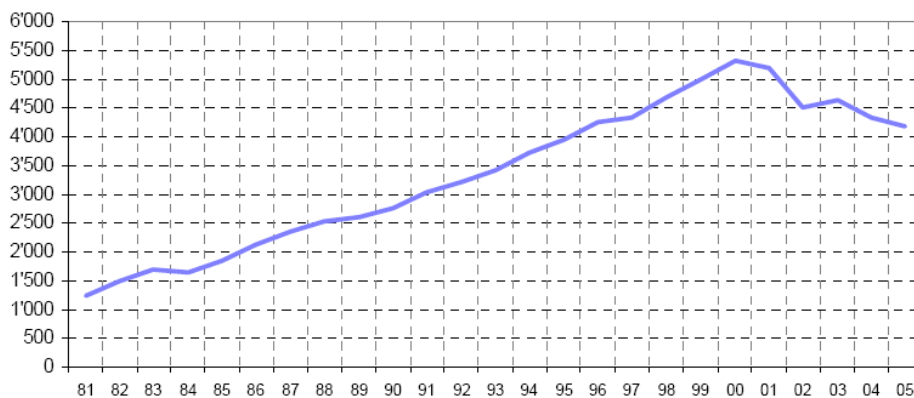
**Figure 54: Total transalpine goods transport**

[Source: Swiss Federal Office for Spatial Development]

In order to manage the increasing traffic through the Alps, Switzerland and the European Union concluded the transit agreement in 1992, which for the first time comprehensively regulated the main issues. Switzerland committed to building new rail tunnels through Gotthard and the Lötschberg, and the EU recognised the Swiss 28-tonne limit for heavy goods vehicles. The period of validity of the transit agreement was limited to twelve years and was replaced by the agreement on overland transport in 1999.

However, traffic through the Alps grew constantly and almost doubled from about 3000 trucks a day in 1990 to over 5000 trucks in 2000. Due to the introduction of a distance based heavy goods vehicles fee, this amount was reduced to almost 4000 trucks per day in 2005 (Figure 55). But, due to the limited capacity of the Alpine passages (tunnels with traffic restrictions for trucks due to safety reasons), congestion has not only become a problem for the people living in the Alpine area, but also for the hauliers.

**Average daily truck traffic**



**Figure 55: Average daily truck traffic over the Swiss Alps**

[Source: Swiss Federal Office for Spatial Development]

This increase in heavy goods vehicle traffic, with all its external effects on the environment and traffic flow, has been a thorn in the side of people living in the Alpine area. In 1989, they started a public referendum in order to limit the amount of trucks passing over the Alps. Swiss citizens voted in favour of this referendum in 1994, thus obliging the Swiss government to change the legislation in order to decrease the traffic over the Alps. With the ordinance of 1999, the amount of transit goods traffic was restricted to 650,000 trucks per year from 2009. The year 2009 was chosen due to the then foreseen opening of the Gotthard rail link through the Alps, increasing the capacity for goods transport on rail.

It was not only in Switzerland that people living in the Alpine area started to resist the increasing growth of traffic, but resistance was also growing in Austria and France. For political reasons, however, it was easier for the Swiss to start the political process against the traffic growth, and therefore the Swiss have been precursors in developing ideas and solutions to manage and avoid a gridlock in the Alps.

## 7.2 Alpine Crossing Exchange

During the political discussion on how to reduce the number of heavy goods vehicles to the goal of 650,000 trucks per year, many ideas arose from various political and technical interest groups. However, how to achieve this target is a challenge. As shown in Figure 56, the estimation for the transalpine heavy goods vehicles traffic has a downward trend (due to the implementation of the distance based heavy vehicles fee LSVA), but it will not reach the ceiling of 650,000 passages per year required by law from 2009 without additional measures; the remaining 400,000 passages have to be reduced in order to reach the target. A government funded study was launched to analyse two proposals to reach the 650,000 trucks target: a slot management with dynamic pricing and a so called cap-and-trade model.

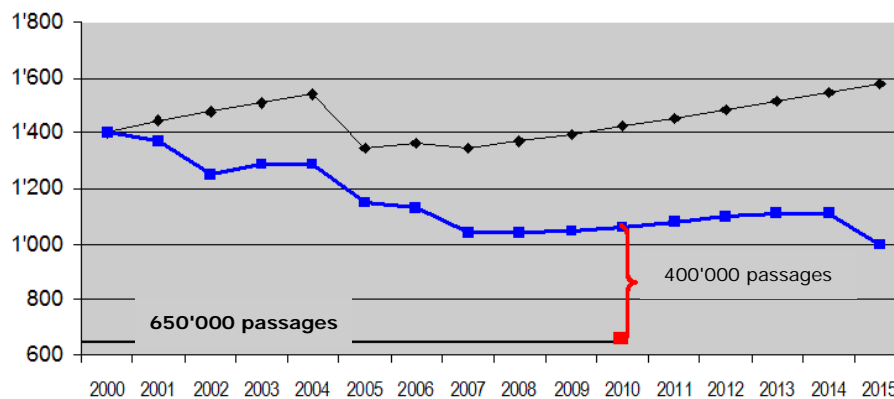


Figure 56: Estimation of yearly truck traffic over the Swiss Alps

Black line: estimation without shift to rail

Blue line: estimation with shift to rail

[Source: Swiss Federal Office for Transport]

However, the aim of this study was not only to find a means to reach this target but also to find ways to:

- reduce congestion at the Alpine passages
- increase the predictability of the transit time for the hauliers
- allocate efficiently the capacity at the Alpine passages
- increase the transparency of the allocation
- create incentives due to the better prediction of the transit time for logistics and planning.

### 7.2.1 The basic models

For the study, two basic models were analysed regarding their feasibility and impact on the transalpine traffic. The *cap-and-trade* model would limit the transit traffic to the required legal maximum and distribute this amount of traffic to the hauliers, whereas the *slot management with dynamic pricing* model is a voluntary system of cost-based, tradable reservation rights, which authorises the passage of an Alpine crossing point during a specific time window or slot. A third model was analysed only partially; the *fast track* model which would allow hauliers willing to pay a fee to overtake the congestion.

### 7.2.1.1 Cap-and-Trade

The cap-and-trade model is a market economy solution for Alpine transit traffic based on warrants for Alpine transit traffic. A warrant is required for every transit passage. Due to the legal ceiling of vehicles for the Alpine transit by the year 2009, the maximum amount of warrants would be 650,000 Alpine crossing rights. The warrants are tradable and it is intended to provide an economically efficient implementation of a volume-based restriction of transalpine, road-based freight traffic. The Alpine crossing rights could be awarded either free of charge, sold at a fixed price, or auctioned off. The auction would be the most efficient form of an initial allocation, with four different methods of how to perform it:

- the *English Auction* with an increasing open bid against each other
- the *Dutch Auction* where the auctioneer begins with a high asking price which is lowered until a participant is willing to accept the price
- the *First-Price-Sealed-Bid-Auction* where all bidders simultaneously submit bids without knowing the others participants bids and the highest bid wins
- the *Vickrey Auction* which is similar to the First-Price-Sealed-Bid-Auction, but the highest bid wins at the price of the second highest bid.

The allocation could take place several times a year (a single allocation per year could be problematic as the demand for Alpine crossing rights by the hauliers is difficult to be planned for a whole year; therefore the allocation should be every quarter for a quarter of the yearly rights).

After the allocation, the Alpine crossing rights could be freely traded. The trade could take place directly between freight transport companies, via intermediaries, or by means of a special platform where the allocation could also take place. Speculation can not be excluded, but as long as there is no asymmetric information, speculative traders could even support the price finding process as well as the liquidity of the market. However, there is no possibility to return the Alpine crossing right. If someone no longer requires their Alpine crossing right, it can only be offered on the market at the current market price.

The Alpine crossing rights would be issued in the form of an electronic permit, which can be printed out before the trip (similar to airline e-tickets with several identification/security characteristics) or displayed on wireless devices (tickets on mobile phones for example). A check would be made at a suitable location as to whether all the vehicles have valid crossing rights. The location could, for example, be at a trickle-counting point in front of the Gotthard road tunnel, or at the entrance to the storage area of a HGV centre situated at the foot of the Alpine crossing. Trucks without an electronic permit would not be allowed to pass these checkpoints and would either have to buy a permit at the market 'on-the-spot' or choose a different route where no permit is required (potentially resulting in a long detour).

The advantages of the cap-and-trade model are:

- It is an effective instrument for the reduction of the transalpine traffic on roads: the reduction required by law can be achieved.
- By the auctioning of the Alpine crossing rights and the adjacent trade, the limited capacity of the transalpine passages is used efficiently.
- Due to a sliding distribution/auctioning of the Alpine crossing rights, the availability of these rights can be ensured throughout the year.



However, there are also some disadvantages:

- According to EU regulation and international agreements, such restriction on the amount of traffic would probably not be acceptable.
- The application of Alpine crossing rights would be mandatory for all heavy goods vehicles (national and international).
- The Alpine crossing right is no warranty for a passage at a certain time or day (e.g. during heavy congestion). But due to the restriction on the amount of traffic, congestion at the Alpine passages should be reduced vigorously.
- There will be no exception for local, short-distance traffic which could discriminate against businesses in the locality of the Alpine passages.

Similar platforms could be developed for Alpine crossings in other countries. However, experience gained with international environmental agreements shows that the negotiation of volume-based targets is an extremely difficult undertaking.

#### **7.2.1.2 Slot Management with Dynamic Pricing**

Due to the fire incident at the Gotthard road tunnel, caused by a heavy goods vehicle and resulting in several fatalities, this important Alpine connection between central and southern Europe had to be closed for two months in 2001 for reconstruction works. As a result of this incident, the capacity for heavy goods vehicles was reduced by 60 per cent: to about 150 trucks in each direction per hour, depending on the passenger car traffic. The capacity management problem was solved by a trickle-counting system that allowed only a limited number of trucks to travel the stretch. The trickle-counting system could not prevent congestion at certain times on this passage (in 2000, the entire traffic could not be managed on the same day during 15 days; however, congestion was less than 15 minutes during 196 days). However, the situation would worsen if the heavy goods vehicle traffic increased. Therefore, other solutions for managing the capacity were evaluated.

A slot management with dynamic pricing scheme involves a voluntary system of cost-based, tradable reservation rights which authorise the passage of an Alpine crossing point during a specific time window or slot. The aim is to improve the utilisation of road capacity and to reduce traffic queues and waiting time. Trucks holding a reservation would be permitted to pass during the specific slot, while trucks without any reservation would have to wait until those with reservations had passed.

An important issue is the length of the slot. For capacity management, a very short slot would be favourable in order to allow maximum utilisation of the capacity, but for the hauliers, a longer slot would allow more flexibility for the truck drivers. As a result, slots of less than one hour were rated as too short. Different slots were discussed in the study: long slots with a duration of half a day, slots for morning/noon/afternoon/evening, and even a combination with different durations (e.g. short, medium and long slots as shown in Figure 57).

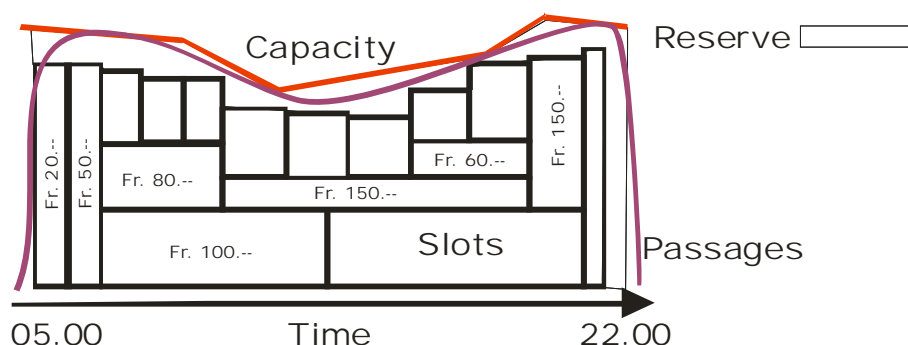


Figure 57: Slot scheme with different duration and prices

It is suggested that the optimal slot will be evaluated when such a scheme is operational. According to the demand, the slots can then be adjusted to the haulier’s needs.

The sale of the reservations would most easily be developed by means of an electronic platform. The reservation rights would be sold either at a fixed or at a variable (demand-based) price. They could also be traded, but not given back. Booking and control of reservations would be made through the reservation system. All trucks heading for the Alpine passage would have to arrive at the checkpoint en route. Those with a reservation could proceed directly to the waiting area for the specific slot or, if the slot is running, continue their trip. Trucks without a reservation would have to proceed to the stand-by waiting area where trucks would be called for the passage whenever there is capacity between the slots.

The advantages of the slot management with dynamic pricing model are:

- The capacity management of the Alpine passages is partly possible: traffic is better distributed during the day and waiting times can be reduced.
- The reservations indicate the expected traffic at a certain time which can be used for traffic management. In addition, hauliers can use this information when planning their journeys.
- There is no obligation to make a reservation; the system is only active in case of congestion.
- Complicated auctioning is not necessary; the haulier who has reserved his specific slot ensures his passage.
- The reservations can be traded; those who have too many reservations can sell them to those in need of them.

The disadvantages are:

- In cases of traffic interruption (e.g. accidents, avalanches), problems with the slot management can occur.
- Slot-lengths of one hour and less are not practicable.
- It is unclear if the cap of 650,000 passages can be achieved.
- Short-range traffic and heavy goods vehicles without reservation hamper the optimal use of the capacity.
- The pricing system could be inequitable for certain users as prices may fluctuate between the time of issue and the specific slot time.

### 7.2.1.3 Fast Track

The fast track model is based on the presently used trickle-counting system. Instead of making a reservation as suggested under the slot management with dynamic pricing model, the truck driver can decide on arrival in the waiting area whether to overtake the congestion by paying a fee or follow the queue. There is no reservation in advance necessary. The published fee for using the fast track can be either fixed or dynamic. If a fixed price mechanism is chosen, it would depend on direction, day and time (similar to HOT-Lanes in the USA). Even the use of seasonal or yearly cards for the use of the fast track could be considered. With a dynamic pricing model, the price for using the fast track would be set according to the optimal rate of traffic. The price should not be too low (otherwise too many trucks will use the fast lane and block it) nor too high (as nobody will use the fast track).

The advantages are:

- Full flexibility for the transport operators as there is neither an auction nor a reservation necessary to obtain a passage on the fast track.
- Easy decision making process for the truck driver: if the cost of a slow or delayed journey is higher than the fee for using the fast track, the use of the fast track will be chosen.
- From a legal perspective, it is easier to implement a fast track system than the cap-and-trade model or the slot management scheme with dynamic pricing.

Disadvantages are:

- The ceiling of 650,000 passages per year will not be reached by this system.
- No reduction in congestion for truck drivers not willing to pay the fast track; they will have to wait longer than before.
- Transport operators will have difficulties with their transportation costs (with dynamic pricing) as the price is not available in advance.

Therefore, the fast track model is the least suitable solution to find a mechanism for the reduction of the traffic to the 650,000 passages target.

### 7.2.2 Technical feasibility and economically supportable

The two basic models for the Alpine Crossing Exchange are technically and operationally feasible. The physical infrastructure is to a large extent already available, and control and trading structures could be set up with very little expenditure.

The cap-and-trade model would lead to an increase in the costs of road transport and to a re-assignment of freight traffic from road to rail. The scale of this effect depends on the target volumes selected and on the accompanying measures.

If the Alpine Crossing Exchange is restricted to Switzerland, there would be a significant rerouting of traffic through the neighbouring Alpine corridors. A coordinated introduction of the Alpine Crossing Exchange in all Alpine countries could avoid this undesirable effect.

With a base of 650,000 trips per year, the price for a crossing right in 2009 has been estimated to be around AUD 200. At that price, the system would generate a gross income of AUD 130 million. The Alpine Crossing Exchange would raise transport costs for all sectors, but no sector would be severely harmed. Analyses of the volumes of transalpine freight traffic which pass through Switzerland show that the transport-intensive sectors already run their freight transport almost exclusively by rail. The reduction of the amount of freight traffic would also lead to cost reductions in terms of road accidents and the environmental impact.

The slot management with dynamic pricing model allows trucks which have a time-critical shipment to make a more rapid journey through one of the Alpine crossings. At the same time, vehicles which do not have a reservation will have to spend more time queuing up. At today's traffic volumes the system would show substantial time gains on only 30 days, whereas the time gained would be insignificant on more than 200 days. This could mean that on these days the supply of reservation rights would exceed demand. The acceptable price for a reservation would then have to be set lower.

On days with high volumes of traffic and correspondingly long waiting times, scarce slots would be allocated on the basis of willingness to pay. In the slot management with dynamic pricing model, generally no other effects are to be expected than for the reservation system. In economic terms however the distribution of the reservations based on willingness to pay would be more efficient than in a system where reservations are allocated to those who are in a position to book at the earliest possible time.

Under both models, the Alpine Crossing Exchange would impose a disproportionately large cost increase for short-distance traffic. Preferential treatment for such traffic would be possible, but would be associated with a number of problems. In either case steps would have to be taken to prevent the creation of "artificial" short-distance traffic (transshipment before Alpine crossings) as an attempt to profit from special regulations.

### 7.2.3 Impact and effects

The Alpine crossing exchange is a feasible, efficient and effective instrument of transport policy. As a market-based instrument, it provides incentives for the optimal use of infrastructure, generates valuable information and ensures that the desired goals are achieved in a cost-effective manner.

The cap-and-trade model can achieve the goal of relocating traffic from road to rail in an efficient and non-discriminatory way. Certainly it has to be assumed that this alternative would require a relaxation of the ban on trip quotas in the national transport agreement between the EU and Switzerland. The aim would, however, have to be an introduction of the cap-and-trade model together with neighbouring alpine countries. This would avoid any undesirable traffic rerouting and would also lead to synergy effects during the introduction of an electronic trading platform. Finally, a coordinated procedure between the alpine countries would facilitate the political viability of an Alpine Crossing Exchange.

The slot management with dynamic pricing model could be introduced by one country alone and would therefore be more likely to be in conformity with international transport agreements. It would make possible a more efficient use of road transport infrastructure and would also mean that journeys would be easier to plan. At today's traffic volumes, however, time savings would be restricted to just a few peak days. For this reason, this alternative offers no significant advantages at the present time. This could change should transport volumes and queues at the Alpine crossings increase significantly. If a system involving the economic use of capacity is introduced, it should certainly include a price mechanism.

### 7.3 Regulatory documents

#### 7.3.1 Bilateral agreements

On the European level the following agreement is of relevance with respect to the studies on an Alpine Crossing Exchange:

- Agreement of the 21 June 1999 on the Transport of Goods and Passengers by Rail and Road between the European Community and the Swiss Confederation (Abkommen vom 21. Juni 1999 zwischen der Schweizerischen Eidgenossenschaft und der Europäischen Gemeinschaft über den Güter- und Personenverkehr auf Schiene und Strasse).

#### 7.3.2 National Regulations

The following Swiss Regulations are of relevance with respect to the studies on an Alpine Crossing Exchange:

- Swiss Constitution, article 84: Alpine crossing transit traffic (Bundesverfassung der Schweizerischen Eidgenossenschaft, Artikel 84: Alpenquerender Transitverkehr)
- Federal Ordinance of the 8 October 1999 on the shift of heavy goods traffic to the rail (Bundesgesetz vom 8. Oktober 1999 zur Verlagerung von alpenquerendem Güterschwerverkehr auf die Schiene)
- Federal Ordinance of the 17 June 1994 on the Transit Traffic on Roads in the Alpine Area (Bundesgesetz vom 17. Juni 1994 über den Strassentramitverkehr im Alpengebiet (STVG)).

### 7.4 Additional information

#### 7.4.1 WEB Links

Links of WEB-sites of governmental organisations or stakeholders with information about AEC:

• URL	• Organisation / Country	• Remarks
<ul style="list-style-type: none"> <li>• <a href="http://www.uvek.admin.ch/dokumentation/00655/00699/00706/index.html?lang=de">http://www.uvek.admin.ch/dokumentation/00655/00699/00706/index.html?lang=de</a></li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">Federal Department of the Environment, Transport, Energy and Communications (DETEC)</a></li> <li>• <a href="#">Switzerland</a></li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">German only</a></li> </ul>
<ul style="list-style-type: none"> <li>• <a href="http://www.alpine-initiative.ch/e/Home.asp">http://www.alpine-initiative.ch/e/Home.asp</a></li> </ul>	<ul style="list-style-type: none"> <li>• Alpine Initiative</li> <li>• Switzerland</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">English</a></li> </ul>

#### 7.4.2 ITS Europe Congress Paper

Additional information about the ACE research project can be found at:

- [http://www.rapp.ch/documents/papers/ITS\\_ACE\\_25168\\_PhJ\\_Paper.pdf](http://www.rapp.ch/documents/papers/ITS_ACE_25168_PhJ_Paper.pdf)
- [http://www.rapp.ch/documents/papers/ITS\\_ACE\\_25168\\_PhJ\\_Praes.pdf](http://www.rapp.ch/documents/papers/ITS_ACE_25168_PhJ_Praes.pdf)

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