# CESARE III PROJECT

Interoperability of electronic fee collection systems in Europe

## D1.1 DOCUMENTATION ON REVISION PROCESS

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## Glossary

*See Annex of D4.1*

## Objective of the document

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 electronically, where this is possible, throughout Europe.

CESARE arose from the concern that many countries were developing independent, national, approaches to interoperability of EFC systems, but that there was no common, international approach. The first phase of CESARE, referred to in this proposal as CESARE I (1998-1999) defined the requirements for technical and operational interoperability between the tolled motorway operations across Europe. The second phase (2001-2002) developed a Memorandum of Understanding [8] defining all technical, organisational and operational rules upon which contractual interoperability among ASECAP members was to be established (it is not clear that this could continue in the current environment post the adoption of the Interoperability Directive on Road Charging and emerging national systems like those in Germany and Austria). The MoU developed by CESARE II reflected the then market demand, and was designed to be flexible enough to be developed and to evolve in the future according to new requirements which might appear.

However, since then the European tolling environment has changed. New actors, new technologies, new enforcement services, new charging schemes and services as well as the new European Directive have to be taken into consideration. Therefore, CESARE III will seek to revise 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). It will also aim to establish appropriate national organisational arrangements to support the participation of partner European countries in the contractual framework and prepare an appropriate set of draft contractual documents (MoU) to support the proposed contractual relationship defined by the revised model.

The work performed in workpackage 1 will

- Identify the requirements from the national EFC schemes (existing and projected) of the members of the Stockholm Group;
- Identify all involved actors and their roles and responsibilities;
- Compare the CESARE model with the interoperability models of the projects PISTA, MEDIA, OMISS, NORTIS and the results of bilateral interoperability arrangements;
- Analyse the impact of the Interoperability Directive on the model;
- Check for potential impact of new technologies;
- Challenge the work performed in CESARE II with the views and needs of key actors, especially for banks potentially acting as issuers, for road transport payment service providers, and for representatives of road transport operators (such as IRU);
- Analyse potential solutions to issues resulting from the differences between governmental and private operators and outline of the key areas that need to be addressed in the CESARE III MoU (taking account of the needs for high level technical, procedural and contractual interoperability).

Provide the CESARE III interoperability model taking into account the:

- Requirements of the national schemes,
- Needs of key actors and input from other initiatives,
- Proposed solutions to key interoperability issues.

# 1. Approach for the revision

## 1.1 Current situation

CESARE I was undertaken entirely by ASECAP members and was focused on the specific need of Tolled Motorway Operators. CESARE II involved several Member States in providing comments and input. CESARE III is intended to broaden the approach developed in CESARE I and CESARE II to apply to all countries in Europe, i.e. private and governmental toll road operators.

These are significant challenges and need to be addressed by CESARE III. These challenges are:

- Supporting new European legislation.
- Involving new actors in the contractual framework
- Supporting new charging schemes and new equipment based on new technologies
- Dealing with new enforcement requirements
- Dealing with different types of service

New European Legislation

The European Directive on EFC Interoperability may have some impacts on the CESARE II outputs. Any impacts need to be identified and analysed. The business model for CESARE may therefore need modification.

Involving new actors in the contractual framework.

The CESARE II business model was designed to support the existing commercial motorway toll operations across Europe in providing a new payment service. However, new national schemes have introduced further actors, which will be described in chapter 2.2.

Supporting new charging schemes and equipment based on new technologies

The focus of the new EFC Directive on CN and GNSS technologies charging schemes for Germany and Switzerland means that the CESARE business model needs to be broadened to incorporate such systems. This will be described in chapters 2.3 and 2.4.

Dealing with new enforcement requirements

CESARE II placed all responsibility for enforcement with the so-called Transport Service Operator. New charging schemes have taken different approaches (e.g. Austria). CESARE III needs to specifically take account of the role of the Enforcement operator within the business model.

Dealing with different types of service

CESARE II deals with tolling. Some charging schemes are legally treated as a national tax, the collection of which involves different business rules and may not require a specific contract to be signed. Some European countries have city congestion charges. At the European level the definition of user charges (meaning time, location or distance based) and tolls (being access or distance based) may not be in harmony with the national legislation. The CESARE business model needs to recognise the different forms of charging.

## 1.2 Methodology

In a first phase all existing interoperability projects have been looked at and experiences analysed. A closer look on the new tolling schemes for Heavy Goods Vehicles (HGV) in Austria, Germany and Switzerland as well as the planned scheme for UK (dropped later as the scheme has been cancelled) has been taken as they have been introduced after the finalisation of CESARE II. The consequences of these schemes have been discussed shortly.

In the next step it was tried to find a common understanding on the names of the entities involved in interoperability process. The WP1 team came to the conclusion that not only different names are used in the different projects and countries for the same entities, but even if the same names are used for entities they often cover different functions. To achieve a common understanding seemed to be impossible. Therefore a more high level approach was taken. A basic model was elaborated that shows the main Roles in the field of the EETS. This model and the associated terms is one of the inputs to the other WP.

A list of tolling functions was elaborated as another main input to WP2. These functions have to be assigned to one of the main interoperability actors and to one of the services to be developed in WP2. Functions with the involvement of two main actors are relevant for interoperability. It is important to define a responsibility for each function.

# 2. Impact from Directive, new actors and new systems

Note: in chapters 2 and 3 names such as Toll Charger, EETS Provider, Service User and Interoperability Management are used following a definition which is given at the end of chapter 4.

## 2.1 European Directive 2004/52 on EFC Interoperability

The European Commission issued the EU Directive 2004/52 on EFC interoperability. The aim of the new directive is quite clear:

> ***Users should be able to drive with a vehicle throughout Europe having only one contract and only one set of OBE to be used for all European electronic toll systems under the Directive***

To this end the Directive:

- constrains the technologies to be used for new systems,
- requires operators to make suitable OBE available to interested users, and
- requires the creation of an European Electronic Toll Service, EETS.

The term "toll" in the Directive includes all types of road fees on the entire Community road network, urban and interurban, motorways, major and minor roads, and various structures such as tunnels, bridges and ferries (i.e. a charge, a payment, a tax, or a duty for permission to pass a barrier or to proceed along a road, over a bridge, etc).. This terminology is used also within CESARE III[1].

The EETS is defined as a service which shall be provided irrespective of the place of registration of the vehicle, the location of the toll scheme, the nationality or residence of the service provider or Service User[2]. The OBE used for the EETS shall be interoperable with all toll systems within the EU[3].

The Directive confirms that every Member State is free to define its own toll regime[4] (the subsidiarity principle) as long as it does not discriminate vehicles from other Member States[5] (the non-discrimination principle).

The Directive merely requires the availability of a European electronic toll service that fulfils the EETS requirements. Therefore the Directive implies that every toll system operator operating an electronic system using an on-board equipment has to accept EETS users on its network. This leads to a break-up of existing

[1] Therefore the expression "all toll systems" includes any kind of systems levying road user fees.

[2] See article 3(2) of the Directive which states that "The service shall allow for contracts to be concluded irrespective of the place of registration of the vehicle, the nationality of the parties to the contract, and the zone or point on the road network in respect of which the toll is due."

[3] See article 2(2) of the Directive.

[4] As is emphasised in article 3(2) of the Directive.

[5] As required in article 70 and the following of the Treaty of Rome (which article 70 - there is not one in the Interoperability Directive?).

monopolies in issuing contracts and on-board equipment to the users. The Directive is less clear that has to offer the EETS. It is obvious that an EETS Provider will only be an EETS Provider if it can offer the service in all European systems. This may lead to difficult commercial situations and may require a regulating body for the EETS.

Within the CESARE III project, WP 3 & 4 clarify the legal issues arising from this directive. They will also determine if the EETS is a service definition or is mandatory by law, having impact on a possible, necessary MoU.

**Impacts from the European Directive 2004/52 on EFC Interoperability:**

- Subsidiarity principle: The definition of toll scheme and service is left at the local/national level
- Non-discrimination principle: EETS users and/or vehicles shall not be discriminated against by the toll system
- Every electronic toll system using an on-board equipment has to accept OBE based on the EETS
- Users have to be offered the EETS
- EETS users have to be accepted in all electronic toll systems (that fall under the scope of the Directive)
- Prescribing to use at least one of technologies for toll schemes
- Break-up of existing monopolies for issuing contracts and on-board equipment to users as well as for manufacturing equipment (onboard and roadside).

## 2.2 New actors

In the intervening years since CESARE II, additional actors have been involved in the road tolling business, especially for heavy goods vehicles (HGV).

### 2.2.1 Governmental entities

The HGV systems in Switzerland, Germany and Austria are under the responsibility of governmental entities (or private entities owned by governmental entities in case of Austria). The same is planned for Sweden and under evaluation in the Netherlands.
In the three operating governmental toll schemes the following structures are applied:

- Germany
  The HGV motorway tolling in Germany is ruled by a federal law, which contains the general obligation to pay tolls to the federal state. The law also allows the federal administration to appoint a private service provider to collect the tolls on behalf of the federal state.
- Austria
  The HGV – toll system in Austria is under the responsibility of ASFINAG. ASFINAG is a private company with a public body. That means that ASFINAG is a state owned operator. The issuing of Service User – contracts and the system operation is provided by ASFINAG Maut Service GmbH (a subsidiary company of ASFINAG) and the ASFINAG Maut Service GmbH will be in charge of all tolling operations in Austria (before the end of 2005 contract issuing and system operation was provided by EUROPPASS on behalf of ASFINAG, but since then EUROPASS has been fully integrated in ASFINAG Maut Service GmbH).
- Switzerland
  The Swiss LSVA law defines the Swiss Customs Authority as being responsible for the toll collection.

The Swiss Customs operate the LSVA system using their own resources (not contracted to an external supplier).

Governmental toll system operators have different legal status, different business relations and are often limited by law in their options when compared with private road operators The mentioned countries are members of a new forum, the Stockholm Group[6], to bring in their requirements to the design of the EETS. They have a major impact on the EETS.
Most of the governmental organisations are restricted in their legal options in the tolling sector. Financial guarantees to foreign entities or toll collection for any organisation are in most cases not possible by law. Possibilities to agree on any obligations to other toll collection operators are very limited, but outsourcing of services from the Toll Charger to other organisations is possible.
In systems where the toll is a tax, there are no contracts between the users and the taxation authority (however there is normally an application or similar to receive an OBU). The obligation to pay the tax is given by the law. Also taxation authorities must have the ability to assess the tax due. This assessment can be different from data measured or collected by technical equipment.
In all governmental systems there is currently only one entity supplying contracts and equipment to the users. In the Swiss system all national HGV are equipped mandatory with an OBU.

### 2.2.2 Turn-key EFC system suppliers and operators

Often the governmental entities have outsourced the supply and operation of their EFC systems to a government owned Agency (Austria) or private organisations / consortia (Germany) for defined time periods, normally based on special national legislation. These supply and operation contracts give them normally the exclusive rights to issue contracts and the on-board equipment.

**Impacts from new actors:**
- Different legal status and different business rules
- Payment guarantees to other organisations not possible by governmental entities
- Governmental entities are not allowed to execute any tasks for other systems
- The toll due must be possible to be assessed/altered by the authorities in tax systems
- Some existing systems do not involve a user contract related to the use of the service

## 2.3 New charging schemes

The term “new charging schemes” describes all charging schemes introduced after the end of the CESARE II project.

### 2.3.1 Free flow network (motorway) tolling

DSRC multilane free flow (Austria)

In Austria the first multilane free flow system was introduced in 2004. In general, there is no big difference to an existing “classical” open DSRC toll system; except that there is no lane separation, no toll booths, all lanes are EFC lanes. There are no physical measures (e.g. barriers) to prevent non- or wrong payers to pass a toll point nor are there possibilities to pay the toll if the vehicle is not equipped with a valid OBU.

[6] Members of Stockholm Group: Austria, Finland, Germany, Netherlands, Slovenia, Sweden, Switzerland, UK

Due to the missing barriers, enforcement is one of the key issues when dealing with DSRC multilane free flow systems. The EFC Operator must therefore have measures to “catch” violators which pass without a valid/functioning OBE.

Autonomous multilane free flow (Germany)

In Germany the first multilane free flow system was introduced in 2005. The basic characteristic of autonomous EFC systems is the absence of fixed roadside infrastructure through the use of GPS/GSM and a manual booking system.

There are no installations on tolled roads (except supporting beacons and enforcement stations). Enforcement is one of the key issues with autonomous systems. As maps are used for the toll road determination, they have to be accurate. Changes or amendments to the road network have to be updated immediately.

### 2.3.2 Area fee systems

Area fee systems charge the user for the use of the network within a defined area.

Time based area fee systems

The user has to pay for being present and/or moving within the area. Currently there is no such system in operation using an OBU, but e.g. London Congestion Charge could introduce in the future an OBU for certain users.

The London scheme charges for travelling within the area at any time between 07:30 and 18:30. Therefore entry and exits as well as movements within the area have to be detected or to be declared (e.g. entry and exit is currently detected via video cameras). The scheme does charge a fee per day being in the zone, independent for the duration of time within the area, nor the distance covered. Once the daily fee is paid the user can travel into and out of the area and within the area as much as he or she wants.

Distance based area fee systems

The user has to pay for the distance driven on the roads within the area (e.g. Swiss LSVA, originally planned LRUC UK). The tariff may be differentiated according to road type (LRUC objective) or not (LSVA). The enforcement issue is even more important as the tolled road network is much wider than in network tolling schemes.

In the Swiss main scheme the vehicles are equipped with OBU that registers the driven distance, border crossings (systems entry and exit) and the trailer (weight) declarations. Equipped users have not to stop for charging reasons at the border crossings (i.e. free flow possible, but for customs procedures not implemented, except some unmanned crossings).

### 2.3.3 Conclusion on new charging schemes

In general, because of the lacking of a common legal framework in terms of fraud management, each system is responsible for enforcing users when they are crossing the tolling point, according to its own attitudes and policy.

It is important to recognise that free-flow systems require a different approach to enforcement than systems based on toll booths with barriers. To achieve an acceptable rate of toll violators either a comprehensive system detecting non-compliant OBU activities and/or a high level of checks of liable vehicles on the road is required in those systems.

To minimise operations costs, the toll operator is interested to have only a limited number of enforcement resources and therefore would require an OBU supporting checking of the compliance.

The detection of violations is usually under the responsibility of the toll operator (slightly different in Germany where the toll operator is Toll Collect and the enforcement is undertaken by BAG). Normally automatic and manual detection of violations are undertaken in the new systems.

Enforcement of violations of any charging scheme is a generally a matter for the toll operator (except Germany). While the enforcement policy must be applied fairly to all users, including foreign drivers, there are inevitably differences in enforcement practices and procedures for foreign drivers. This is due to the fact that a toll operator does not usually have access to the national vehicle databases in order to identify the person responsible for the charge.
Given the increase in "free-flow" systems and in cross-border traffic, the enforcement of foreign drivers is an increasing problem. The current legal framework for cross-border enforcement of tolls is less than satisfactory.

**Impacts from new charging schemes:**
- Database (maps) necessary as basis for tolling in autonomous systems
- If there are databases on-board they need to be updated (e.g. maps, tariffs)
- Enforcement separated from tolling
- Distance-based area fee charging requires accepted distance measurement (on all roads at all times)
- Current legal framework for cross-border enforcement of tolls is less than satisfactory
- Misbehaviour or malfunctions lead to toll violations

## 2.4 New technologies

In recent years new technologies have been introduced in tolling. They can be divided in mainly two classes:
- technologies supporting fee determination
- technologies to communicate with OBU.

### 2.4.1 Technologies supporting the determination of the fee

Determination of toll road usage

One of the first steps to determine the fee is to locate the vehicle if it is on a toll road. In classical systems this has been done by DSRC beacons. With **satellite positioning** and **map matching procedures** an additional method has been introduced.
One can also use both the classical and the new technologies in the same system; one for the fee determination and the other for supporting the correct fee determination. For example, the entry and exit in the Swiss km-charging scheme (LSVA) are detected by DSRC while satellite positioning and map matching is used to verify the entry and exit into the Swiss scheme. In Germany infrared DSRC beacons are used for identification of road toll usage at locations with difficult GPS reception.

Determination of fee relevant data

The fee in each system is dependent on different parameters.
Most of the new systems require variable declared characteristics. Currently no system uses a technology to automatically alter fee relevant characteristics. The alteration has in all systems to be done manually.
The driven distance can either be measured or determined from map matching procedures. For measuring the distance one can use for lorries the certified tachograph (used in Switzerland as prime measurement) or the GPS (used in Switzerland as secondary measurement for checking prime measurement). The fee can also be calculated by determining when the vehicle is on specific road sections with known lengths (used in Germany).

### 2.4.2 Technologies to communicate with OBU

In DSRC systems the OBU and the road-side equipment interact and produce a tolling transaction. This is transferred from the road side equipment to the central system. The DSRC link can also be used for altering data in the OBU. Because of the short presence of the vehicles in the communication zone only little data exchange volume is possible.

Mobile communication technologies like GSM (used in Germany), GPRS or UMTS (not yet used) allow data transfer at all times when the OBU is in the area of base station cover. GSM/GPRS covering most of the road network in Europe. The time for data exchange is more flexible and the possibility to have a longer communication allows also higher data volumes to be exchanged. With GSM/UMTS it is also possible to establish a connection with a selected OBU.

Because of these new capabilities in data transfer it is possible to allocate data processing at different locations (at OBU, central system of EETS Provider and at central system of Toll Charger), while this is defined in details for DSRC systems. In the German autonomous system the main processes are allocated within the OBU, but other autonomous architectures are discussed.

For data transfer also physical media can be used (e.g. parameter updates in Switzerland by chipcards).

For enforcement purposes it is necessary to communicate with a DSRC link because a real-time access is necessary on the spot. This is not possible via a mobile communication network (identification of OBU to call is difficult, time to open connection is too long).

### 2.4.3 Other issues on new technologies

The integration of new technologies and some new charging schemes (e.g. Switzerland) require new OBE. These OBE incorporate more components, sensors, functionalities and interfaces than the existing classic DSRC OBU. Because of the complexity and the importance of correct installation, the installation of such OBE has to be done in a professional environment or authorised garage.

Currently, in all systems the OBE is “certified” for the use in the "home" EFC system. Especially in tax systems it is important that the tax authority has the control of all processes to determine the fee.

Therefore OBE for use as part of a common service has to be certified. A common certification has to be accepted by all Toll Chargers or the certification has to be done by each Toll Charger. Any change to certified equipment requires a re-certification, especially in an international and interoperable environment. The installation of new databases and software on OBE may also cause a re-certification of the OBE. Probably each soft- and hardware configuration has to be certified as they may interfere each other.

**Impacts from new technologies:**

- Specification of common requirements for OBE to support EETS
- Process of OBE certification and acceptance by all Toll Chargers is needed.
- Specification of common requirements for centralised processes at an EETS Provider for autonomous systems (if any possible)
- Process of certification for centralised processes (if any possible) and acceptance by all autonomous Toll Chargers is needed.
- Not all sensors for supporting the fee determination and enforcement of existing systems are clearly covered by Directive
- Procedure for incorporation of new technologies needed
- No common method of charging in autonomous systems
- DSRC tolling equipment not operable in autonomous systems

- On the spot enforcement has to be possible
- Some systems require redundancy checks of prime measurement within OBE
- OBE with new technologies is more complex and expensive than simple DSRC OBE
- More complex OBU needs (professional) installation
- More complex OBU requires more detailed certification
- Certification of OBU with different or changing soft- and hardware configurations is difficult

## 2.5 New services

### 2.5.1 Mandatory EFC service for all users

In Austria the use of the EFC service is mandatory for heavy vehicles. There are no unequipped users allowed on the motorways. All users have to equip themselves with an OBU.
In order not to discriminate occasional users the OBU has to be available all the time within a necessary time frame and to a limited price.
Mandatory EFC Services are regarded only as legally possible if the price of the OBU is not significantly higher than a passage through the system and the installation does not impose high costs or a long installation time.
In Austria most of the OBU costs are borne by the Toll Charger.

### 2.5.2 Mandatory EFC service for national / frequent users

In Switzerland the HGV EFC Service is mandatory for national users (as the toll is on all roads they are regarded as frequent users). Foreign users can use either the EFC service or the manual declaration system. The high cost OBU is completely borne by the Toll Charger, the installation costs are covered by the user.

### 2.5.3 Free choice on available EFC service

In Germany the user has a free choice either to use the EFC service or the manual booking system. The high cost OBU is completely borne by the Toll Charger, the installation costs are covered by the user.

### 2.5.4 Conclusions

The OBU costs are often borne by a Toll Charger in order to promote the EFC Service or to increase the political acceptance. Up to now the service definition including the OBU costs are always in the domain of the local/national Toll Charger. In general it is the service definition that determines the price of the OBU.
If the service definition is outside the domain of the local/national Toll Charger, the OBU costs have to be covered by the service offering entity.

**Impact from new services:**
- It is not clear who will finance the EETS OBU

## 2.6 New requirements

### 2.6.1 Variable declared characteristics

In existing DSRC systems fee relevant characteristics are mostly measured; in some also declared characteristics stored either on-board or in a central database are used. In most of the new systems additional fee relevant characteristics have been added which are variable (e.g. current number of axles). Currently no system uses a technology to automatically alter fee relevant characteristics. The alteration has in all systems to be done manually. In Germany and Austria the necessary declaration of the number of

axles is done by a button. In Switzerland the weight of the trailer has to be known and is entered in the OBU either via the keyboard or by inserting a chipcard.
The declared characteristics will be either declared by the driver on the trip or by the Service User when establishing the contract. In some countries the declaration is checked by authorised staff (even taking copies of documents) while in others these characteristics are not checked when establishing the contract. The level of enforcement needed is considerably lower for checked declared characteristics. Currently the Member States will be asked to vote to require Issuers to certify a common set of parameters.
In future it may be possible that certain variable parameters are automatically measured by the OBU.

Axles
The number of axles of the current vehicle combination is a fee relevant characteristic for example in Austria and Germany. This characteristic is not a fixed one. It will change when a trailer is connected. Therefore this characteristic is variable and needs manual input in the current systems
Weight, vehicle class
The maximum permissible weight of the current vehicle combination is a fee relevant characteristic for example in Switzerland. This characteristic is not fixed. It will change when a trailer is connected. Therefore this characteristic is variable and needs manual input in the current systems.
In some systems the weight of the pulling vehicle determines on the one hand if the vehicle is charged and on the other hand which tariff applies. This characteristic is not variable. Often this characteristic is not stored in weight, but transformed into a vehicle class.
Emission class
In some systems there are different tariffs for the same types of vehicles depending on their emission class.
Other
Additional parameters in the EETS are possible upon agreement.

### 2.6.2 Special Commercial Conditions

In some countries or some systems, there are special commercial agreements based on the volume of passages from a Service User. Such commercial agreements may not discriminate users from other countries with similar potential, i.e. they should be granted for all users. Therefore, an interoperable system should also offer the use of such special commercial agreements to be applied for that service; otherwise, companies with large fleets will not subscribe to the interoperable service, but will use the special agreement as a local service. It will be WP2 which has to decide on this service requirement.

### 2.6.3 Reselling tolls

While in some toll domains reselling of tolls is possible, this is not possible in other toll domains. Especially in domains where the toll is a tax the reselling of taxes may not be possible.

### 2.6.4 VAT

Some European toll systems involve the charging of VAT. This is very important for commercial vehicle operators as they can reclaim the VAT. The refund of VAT has become a very important issue in the transportation business governing tolls. The issue was already addressed in CESARE II, but was not solved. There are established transport service providers who provide commercial vehicle operators with payment cards and offer VAT recovery services. This is achieved by buying the services and "reselling" them to the

user. By doing this they pay the VAT rate where the services were consumed and charge the VAT rate where the user is based. This reseller model is not always possible for toll operations.

This has a bearing on the requirement of the Directive to provide a single invoice. In practice a separate VAT invoice will have to be provided for the services consumed in each country. This can be provided to the user in a single package and summarised in a single statement asking for payment. Finding an appropriate organisational framework which will support the recovery of VAT was a real challenge to CESARE II and remains an issue for CESARE III.

**Impacts from new requirements:**

- Classification characteristics stored in OBU
- Fixed and variable declared characteristics are important fee relevant data
- Variable declared characteristics require manual interaction of the driver (instructions)
- Method of registration of fixed declared characteristics is important in relation to enforcement
- Special commercial conditions by some Toll Chargers have to be offered to all road users independent of the EFC Service
- Reselling of tolls is not always possible and desirable
- VAT refund was not solved in CESARE II, but will be required for a widespread EETS.

# 3. High Level Requirements on EETS

## 3.1 Overview

The impact of the Directive, new actors, new technologies, new system concepts and new requirements are leading to new high level requirements for interoperability in general and for the EETS in particular.
These high level requirements are needed to develop a general and generic basic model.

The high level requirements are covered by the service definition of WP2 and the contractual framework of WP4. WP2 develops additional and more detailed requirements.

## 3.2 Toll Charger and Scheme high level requirements

### 3.2.1 Subsidiarity principle

The tolling and collecting principles is in each Toll Charger/scheme operator's responsibility. The definition of the tariff model, technologies used and of the enforcement strategy is at the local/national level. But EETS users have to be accepted and therefore a minimum of agreed technologies has to be introduced.

### 3.2.2 Payment guarantee by EETS Provider

When a vehicle, equipped with an interoperable OBE, enters the toll domain, the respective Toll Charger must have assurance that the tolls will be paid by the user's EETS Provider. Therefore, the Toll Charger will have the requirement of payment guarantees from EETS Provider for the use of their services as registered by the EFC system.
If the Toll Charger has the legal authorisation, the payment guarantee shall also cover assessed charges which differ from the tolling transaction registered by the OBU and/or roadside equipment (e.g. missing single transactions for a complete motorway trip in Austria under some conditions, different assessment than registered in Switzerland upon suspicion).

### 3.2.3 Limitations of entities

Some entities operating a complete toll system today are not allowed to provide payment guarantees to other organisations and therefore can not act as an EETS Provider. Additionally most governmental entities are only allowed to offer services defined by toll laws. This may exclude services required by other Toll Chargers and EETS Providers.

### 3.2.4 Business case

Each Toll Charger has currently a service for all user groups (e.g. frequent and occasional user, domestic and foreign users etc.). Therefore the EETS is a future user group which has been previously part of the existing user groups. The Toll Charger is unlikely to receive any additional income arising from the establishing of EETS users.
The focus of the Toll Charger is to capture the fees (or relevant data) relating to their own system as efficiently and effectively as possible. Hence, the costs for the Toll Charger for supporting the EETS and handling each EETS user shall be not higher than for users of their normal services. Small implementation costs would be acceptable.

The Toll Charger will only be willing to pay for the services he requires from the EETS Provider. The commercial conditions between the Toll Charger and the EETS Provider might reflect the quality and quantity of the received services.

#### 3.2.5 Certified OBE

The Toll Charger wants to keep the control over its system. By accepting interoperable OBU, the Toll Charger will require that these EETS OBE fulfil defined minimum technical standards. These standards and requirements must be approved by the Toll Chargers or a common approval body before the OBE is certified for use.

#### 3.2.6 Personalised OBU

Heavy vehicles require the personalisation of their OBU already today. This will be a requirement for the EETS Service as well.

#### 3.2.7 Enforcement

In general, fraud detection must always be done locally. Therefore the EETS has to support the local enforcement.
The enforcement process is therefore considered out of the scope of the project, but following issues are further considered:

- The EETS OBE allows the (autonomous) Toll Charger to specify a set of measures which include cross-checking of fee relevant data.
- Some assistance may be requested by the Toll Charger from the EETS Provider for users using EETS. This may include (depending upon on local legislation):
  - identification of the registered keeper/EETS Service User
  - identification of the liable person[7]
  - forwarding of toll and fines
  - collection of toll and fine

  These additional services should be considered in the other Work Packages.
- Blacklists have to be distributed between every EETS Provider and all Toll Chargers. However, there is no exchange of blacklists between the Toll Chargers.

### 3.3 Service User requirements

#### 3.3.1 One Contract

From the Service User's perspective, *one contract* for all European toll road systems is the most important requirement.
The Service User is interested to have only one single point of contact for all business relations. Therefore, a Service User requirement is that these EETS Providers have sole responsibility for taking care of everything that can arise from the use of the OBE on the toll roads, especially when travelling abroad on those roads and where assistance is needed.

[7] By using a construction similar to the one in article 5 of the draft directive as proposed by VERA 2.

An open discussion point is if the Service User has more than one Service Provider, e.g. one for its local service and one for the interoperable service. There might be cases when such a choice is desired but the participants of the workpackage decided that this is a desirable, but not essential requirement. It was also noted that this was contrary to the aims of the EETS.

### 3.3.2 Availability of Service

The Service User expects to make the EETS contract in the country where he wants to and is interested to have a selection of different EETS Providers. He is also interested to use existing business relations and payment means. The Service User expects to be able to use the EETS to benefit as soon as possible.
EETS user shall not be discriminated in toll systems compared with other users (every available tariff has to be offered to all users of the same vehicle class / configuration at that time of day etc).).

### 3.3.3 VAT refund

The Service User is interested to have the possibility to reclaim the VAT paid in the different systems and is interested to have the reclaiming included in the service.

### 3.3.4 Use of the OBE

The Service User has a high interest in reliable OBE as the responsibility for the correct OBE functionality will stay with the user. The OBE has to indicate the proper functionality in operation. Instructions in case of malfunctions shall be available from the EETS Provider. A common and easy operation of the OBE within the various systems should be envisaged. The OBE should not distract the user in an unsafe way when the vehicle is moving. The Service User should be able to monitor the correct functioning of the OBE in order to judge if he is compliant.

### 3.3.5 Use of the Toll Road Service

The Service User expects to be informed about the use and the tariffs of the toll road. He also expects to have clear indications on the road when different behaviour is expected from EETS users.
If the EETS Service is not working properly, a degraded mode of payment must be available in order to continue the trip (without becoming a violator).

## 3.4 EETS Provider requirements

The EETS Providers have the (only) direct relationship to the Service Users. Therefore, they are interested in the fact that the service for which they issue the service rights, the payment of toll through EFC, obeys to specific quality criteria.

### 3.4.1 Business case

The EETS Provider wants to be able to charge to the Service Users a reasonable fee for the use made of the EETS and also to the Toll Chargers.

### 3.4.2 Reliable and network-wide EETS implementation (non-discrimination)

That means that the EETS Providers are concerned to be sure that:

- Its Service Users can use the EETS all over the Toll Chargers' networks,

- The same tariffs for its Service Users shall be applied by the Toll Chargers to the EETS Provider as for other (local) users,
- The commercial agreements with the Toll Charger are based on fair and non discriminating principles.

#### 3.4.3 Reliable OBE

The EETS Provider requires reliable OBE, i.e. OBE that has been shown to operate according to agreed specifications. He wants to minimise the handling costs with OBE and guarantees the availability of the service to Service Users.

#### 3.4.4 Fraud proof OBE and genuine transactions

The EETS Providers are responsible, by contract, to pay the Toll Chargers for financial claims of transport services used by its Service Users. In relationship to this, the EETS Providers are concerned to verify that they are able to recover the payment to the Toll Chargers from their Service Users.
They are willing to verify that:

- The OBE that they provide to the Service Users cannot be abusively produced, replicated or cloned, allowing unauthorized use by other parties.
- The Toll Charger's claims for the use of transport services by Service Users are genuine and effectively correspond to Service User's use of the network.
- The Toll Charger's claims correspond to EFC charges incurred by the Service Users. This is the same as the point above.

Moreover, the EETS Providers want to be able to:

- Revoke ("blacklist") contracts within a fixed and defined lapse of time, cancelling the obligation for payment of claims related to these contracts to the Toll Chargers.
- Prevent their OBE from being used for non-authorised services.

### 3.5 Legal/European requirements

#### 3.5.1 National laws

The EETS will recognise national laws (e.g. tolling law, VAT, data protection, data privacy etc.) as suitably amended in line with the Directive.

#### 3.5.2 Mandatory EETS

The Directive requires every Toll Charger to accept Service Users with EETS equipment and an EETS contract. Therefore an EETS Provider has to offer the Service for all Toll Charger domains.
For the EETS a common service definition is required. Changes on the EETS definition have to be applied and accepted by all participants.
A common certification of OBE and other needed services would reduce overall costs, but requires a common definition and agreement.
The service definition is dependent on what is given by the regulatory level and what can be defined on a common or bilateral contractual level.
This issue has to be considered in further details in WP 4.

# 4. Development of the CESARE EETS Model

## 4.1 Introduction

The CESARE II project defined a concrete "business model" for describing the basics of how interoperable EFC would work in an inter-organisational context (see chapter C.1 for details on the CESARE II model). The CESARE II model was focused on existing EFC-systems and thus adapted to DSRC-based systems and mainly on motorway and bridge tolling schemes.

Considering the developments on new actors, schemes, technology the EFC systems to be described are much less similar in CESARE III than in CESARE II. Thus, the CESARE II model has to be enhanced in two ways:

- Avoid details (at the basic level) that may not be the same for all different schemes.
- Describe the basics in such a general way that it may fit all foreseen systems.

Hence the approach of CESARE III is not to make a new model, but to take the basic building blocks of CESARE II and express these in a way that takes into account all the impacts of these new developments; actors, schemes, technology, services and the EU-Directive. This further development of the CESARE II model gives a more general and abstract perspective and does explicitly avoid naming organisations at the basic level. Organisations and other actors can be defined at a later stage when the main building blocks and interfaces have been evaluated.

The following section discusses some of the basics of how CESARE III approaches the EFC interoperability model.

**EFC-modelling**

There are three basic roles in an EFC payment system:

- Someone *buying* a road usage
- Someone *selling* the road usage (and are using EFC to charge for it)
- Someone *providing an accounting system* (EFC) for paying for the service.

Note: In EFC-taxation systems the wording is slightly different but the meaning is the same. Here we may say that someone is *paying (a tax)* for a transport service and that the authorities require *payment* for certain road use.
For interoperable EFC-systems there is also a need for an additional overall management role to take care of any overall issues (e.g. common specifications, regulations). This is defined below.
The assumption in CESARE III is that it is possible to define any Function of an interoperable EFC system in relation to these four basic Roles. Any Function must be sorted into one of these four "boxes". There is always a "home" part of a system that is used "away" for EFC-payment.

**Existing organisational models**

CESARE III WP1 has done an extensive analysis not only of the CESARE II model but also of a large number of interoperability models in use in Europe today (see annex). These schemes represent concrete realisations of interoperability in terms of real organisations that interact in certain ways.

When comparing these national organisational models with each other CESARE III realised that the actual organisational solutions differ between all these schemes. Although there is a common "core" functionality different countries have different organisations, name for organisations, responsibilities, arrangements, etc. It is simply not possible to find a one-size-fits-all solution that is common for all involved EETS actors and countries. Such a model would also be too detailed to be comprehensible.

The second part of this analysis concerns the need for a detailed common model. Do all the countries and schemes need to be organised in the same way? The CESARE III approach is that the need is to define the core responsibilities and interfaces between "home" and "away" functionality, and that there is no need to define in detail how these things are solved *internally*. It can be done within each of these core Roles as long as the interfaces remain the same. Then each toll domain or MoU-area can define their own organisational model for how they organise things (see example below). Note also that the EETS is an "add on service" to existing frameworks that shall not need to change because of the EETS.

**Relations between Roles, organisations and functionality**

The analysis and model so far is abstract, but in the end interoperable EFC have to be realised in real life terms of real organisations performing specific and well-defined functions.

Hence, the CESARE III concept requires that each relevant Function in the pan-European EETS is defined and that the responsibility is assigned to one of the basic Roles of the EETS according to the model (Function is defined later in this report).

The CESARE III concept provides a toolbox for organisational arrangements (done in WP3 and WP4), which may be adapted to each areas requirements and organisational layout.

As the CESARE III EETS model is an *abstract* model, defining the core and common parts of interoperable EFC, it also requires a second step to be put into practise. The terms used here need to be defined.

The *Role* in the model is a grouping of *Functions* in the co-operation that is interoperable EFC.

The responsibility for a Function within a Role is taken at concrete level by an *organisation* (or a *legal entity*) being present in real life. An organisation signs contacts and guarantees the performance of Functions it is responsible for. Often an organisation is responsible for a group of Functions (but it may not have to be all the Functions of a Role). This grouping of Functions is **different for every toll charging scheme**. The nature of organisations can also be different between toll charging schemes (i.e. private organisations, governmental organisations, joint undertakings).

Note that an organisation taking responsibility for specific Functions may freely delegate the operations of these Functions to other organisations. It may co-operate with other organisations in performing its services. It may form clusters or groupings to do this. As the EETS is an additional service to existing EFC-services the organisation may otherwise be an organisation for completely different things, being e.g. a bank, EFC-operator, issuer of payment means, road authority, government, transport company, telecom operator and more.

By keeping the CESARE EETS model on a generic and abstract level (Roles) the needed flexibility on the concrete part (organisations) is enabled.

## 4.2 CESARE EETS Model

CESARE II proposed a clear separation of the role of selling road usage for the role of providing an accounting system. This was confirmed also by CESARE III but the definition needed to be more general.

With this separation of the two main Roles concerning the Tolling service, those operators of toll charging schemes which are not willing or are legally not in the position to offer the EETS Service to their clients (e.g. some governmental operators shall not operate abroad) allow the EETS to be offered to Service Users by the use of the interoperable services from a third party..

The definition of the names of the Roles shall explicitly prevent misinterpretations. Therefore no commonly used names close to expressions like ”contract issuer” have been used as they would imply already some limitations on the grouping of functions or are already used for certain organisations a specific set of functions.

Within WP 1, a basic model was designed in order to give a general overview of the EETS. In this basic model, four Roles are identified as being part of an interoperable EETS service.

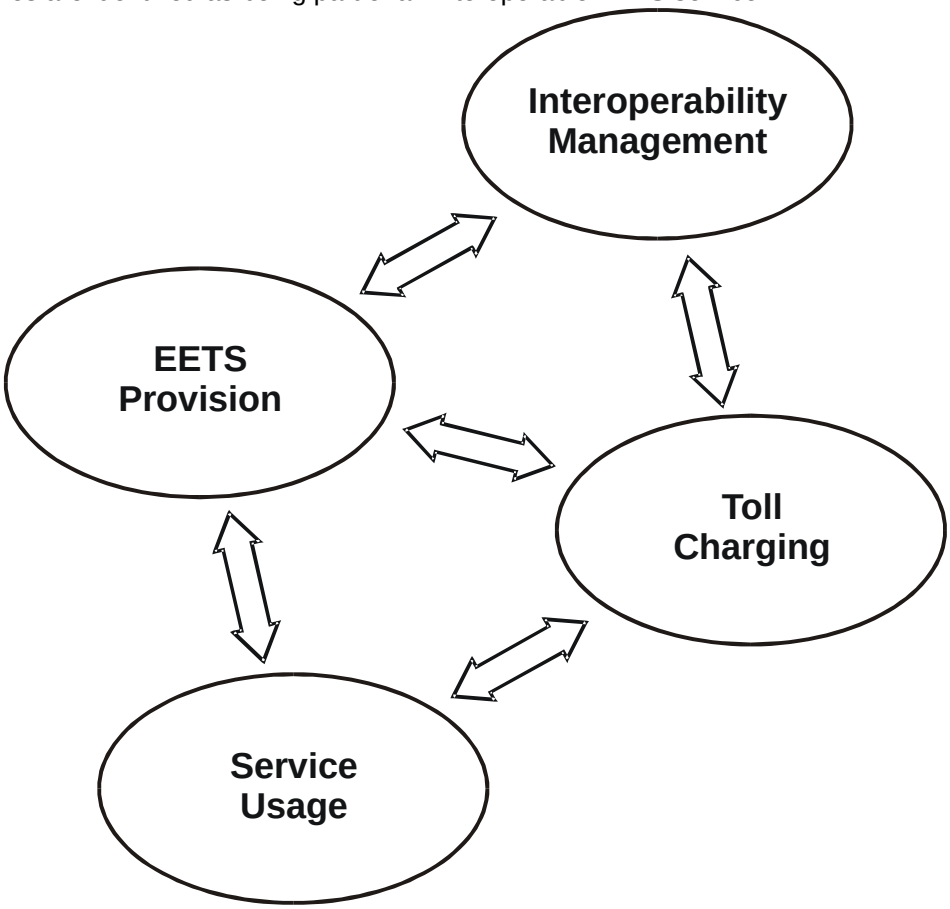


Figure 1: CESARE EETS model

The Roles can be defined as follows:

Toll Charging Role
Toll Charging means providing a transport service (often road usage) to a Service User and charge the latter a fee for this (the "toll"). The responsibility for levying toll in a toll domain is part of the Role and results in claiming payment from a third party within the EETS Provision Role.

EETS Provision Role
EETS Provision means providing equipment (OBE), contracts and payment means to those who want to use the EETS. EETS Provision includes claiming money from users and guaranteed payment for genuine claims received from the Toll Charging Role.

Service Usage Role
Service Usage means taking advantage of the EETS for payment of tolls in the toll domains of the Toll Charging Role.

Interoperability Management Role
Interoperability Management gathers the functionality that deals with overall management of interoperable EFC. This includes rules for interoperability, id-schemes, certification, common specifications, etc.. Therefore this Role represents the regulatory Role of the EETS interoperability scheme.
The setting of rules can be on the regulatory level if (parts of) the service definition is integrated in (European or national) law – e.g. the Directive. Some of the rules can also be agreed between the participants upon a contractual relation. New organisations might be set-up for this purpose.

In real life, the Functions of one Role can be performed by a person, an organisation, or several organisations acting together, as each context can develop its own architecture.
In Cesare III, it was decided not to enter in the details of each of this architecture, but nonetheless there may be a need to name a representative of a Role that would perform all Functions of one Role, and only those Functions.

For example, an organisation within a Toll Charging Role will sign contracts with organisations within the EETS Provision Roles. This is complicated to be described using the names of the roles. In these contexts the generic representative of this role is used, i.e.:

| | |
|---|---|
| **Toll Charger**: | generic representative of a toll domain within the Toll Charging Role |
| **EETS Provider:** | generic representative of an organisation taking the responsibility for the EETS Provision within the EETS Provision Role |
| **Service User:** | generic representative of the Service Usage Role |
| **Interoperability Manager:** | generic representative of the Interoperability Management Role |

**Important: A generic representative of a role is NOT by all means always one organisation or one entity. There can be different organisations or entities representing the role depending on the interface function between the roles.**

In Annex A there is an explanation how actors of other models fit in the CESARE EETS model.

The following figure shows a possible situation with 4 toll domains in 3 countries with 3 different EETS Providers (Interoperability Management Role and Service Usage Roles are not shown):

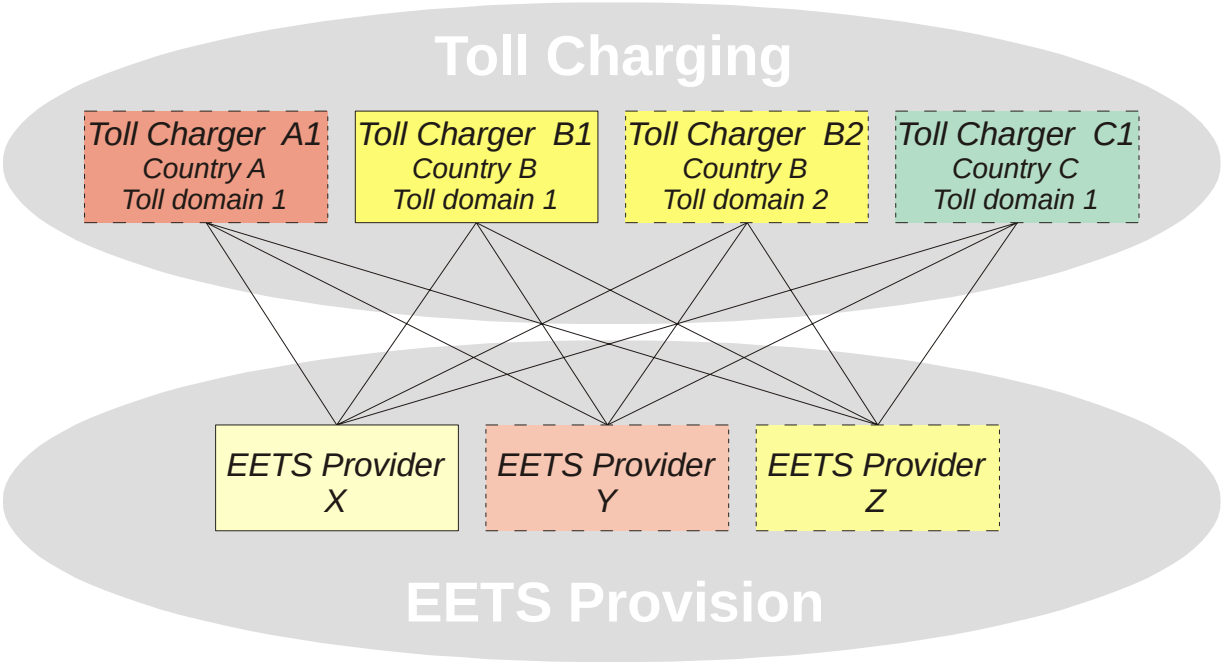


Figure 2: Example of relations between Toll Charging Roles and EETS Provision Roles

Explanation:
In country B there are two toll domains represented by two Toll Chargers. All Toll Chargers in the three countries have a contractual relation with all EETS Providers. But Toll Chargers have no mandatory contractual relations between themselves and also there is no contractual relation between the EETS Providers.

In Annex A there is a more detailed example showing how a Toll Charger or an EETS Provider can be organised.

# 5. Basic functions

## 5.1 Introduction

For the definition of the EETS it is important to have a clear assignment of the responsibilities of the basic tolling functions to the main Roles.

Some functions are difficult to assign especially in autonomous systems as there is not yet a final model agreed. For these functions there has been an attempt to give responsibilities for different options.

The list of functions and proposed responsibilities are the major input to the other work packages next to the basic model.

The functions are grouped as far as possible according to the lifecycles of the EETS and of the Service User as well as the general responsibility of the functions.

The detailed description and explanation of all basic functions are in the Annex D.

## 5.2 List of functions

| Function \ Actors | EETS Provider (EP) | Toll Charger (TC) | Service User (SU) | Interoperability Manager (IM |
|---|---|---|---|---|
| Set-up and maintain service definition | | | | x |
| Set-up and maintain OBE/RSE/CS test specification | | | | x |
| Set-up and maintain common contract terms definition | | | | x |
| Set-up and maintain data exchange specifications | | | | |
| Set-up Interoperability Management Organisation | | | | x |
| Set-up Security / Key entity | | | | x |
| Set-up Dispute Management and resolve disputes | | | | x |
| Certify OBE/RSE/CS | | | | x |
| Monitor OBU/Contract ID schemes | | | | x |
| Monitor service operations (monitor EETS Provider/Charging) | | | | x |
| Promote service | x | x | | x |
| Issue list of valid contracts providers (EETS Provider White List) | | | | x |
| Accept service defintion | x | x | | |
| Set-up commercial contracts | x | x | | |
| Set-up data exchange network | x | x | | ? |
| Set-up distribution network (OBE/contracts) | x | | | |
| Set-up user support / help desk | x | | | |
| Set-up issueing and payment services | x | | | |
| Install / adapt ETTS equipment (CS/distribution network) | x | | | |
| Issue contract to user | x | | | |
| Accept payment means of user | x | | | |
| Inform user generally on service | x | x | | ? |
| Acquire vehicle registration information | x | | | |
| Acquire user information | x | | | |
| Personalise OBE | x | | | |
| Initial database (map, tariffs) in OBE | x | | | |
| Make certified OBE available | x | ? | x | |
| Install and mount OBE | ? | | ? | |

| Function \ Actors | EETS Provider (EP) | Toll Charger (TC) | Service User (SU) | Interoperability Manager (IM |
|---|---|---|---|---|
| Modify contract | x | | x | |
| Modify payment means | x | | x | |
| Modify OBE data | x | | x | |
| Update map, tariffs | ? | ? | ? | ? |
| Cancel contract | x | | | |
| Issue Black list to Toll Chargers | x | | | |
| Issue Security elements to Toll Chargers | x | | | |
| Set-up tarif and tolling structure | | x | | |
| Install EFC equipment (CS/RSE) | | x | | |
| Set-up central system and payment services | | x | | |
| Distribute keys in EFC system | | x | | |
| Issue definition of processing of sensor data | ? | x | ? | ? |
| Issue "roaming" details | ? | x | ? | ? |
| Update map and tariffs (to EP and/or SU and/or IM) | | x | | |
| Declare variable parameters | | | x | |
| Collection of sensor data | x | | ? | |
| Inform user on OBE status | x | | | |
| Inform user on tolling obligation when entering/leaving road | | x | | |
| Inform user on correct lane use | | x | | |
| Perfom tolling communication (DSRC) | x | x | | |
| Security check (DSRC) | | x | | |
| Calculate fee (DSRC) | | x | | |
| Store tolling transaction (DSRC) | x | x | | |
| Inform user about performance results (DSRC) | ? | x | | |
| Process sensor data (GNSS) | x | ? | | |
| Determine fee (GNSS) | ? | ? | | |
| Inform user about sensor processing results (GNSS) | x | ? | | |
| Store tolling transaction (GNSS) | ? | x | | |

| Function \ Actors | EETS Provider (EP) | Toll Charger (TC) | Service User (SU) | Interoperability Manager (IM |
|---|---|---|---|---|
| Claim payment from EETS Provider | | x | | |
| Issue invoice to EETS Provider or user (or invoice elements) | | x | | |
| Give assistance in case of user complaints on performed transactions | | x | | |
| Give assistance in case of operational user complaints | | x | | |
| Receive claims from Toll Charger | x | | | |
| Check claims | x | | | |
| Pay Toll Charger | x | | | |
| Settle user account | x | | | |
| Issue invoice to user | x | | | |
| Issue itemised transaction list upon user request | x | | | |
| Inform user about account status and account events | x | | | |
| Receive user complaints on charged transactions | x | | | |
| Inquiry on complaints on charged transactions | x | | ? | |
| Inform user about result of inquiry on complaints | x | ? | | |
| Receive operational user complaints | x | | | |
| Inquiry on operational user complaints | x | | | |
| Inform user on solving operational user complaints | x | | | |
| Handle OBU according to requirements | | | x | |
| Pay account/invoice | | | x | |
| Contact help desk | | | x | |
| Detect vehicle on tolled road | | x | | |
| Identify tolling transaction or correct functioning of OBU | | x | | |
| Check Black List | | x | | |
| Determine (potential) non-compliant activities | ? | x | | |
| Capture legal evidence of non-compliant activity | | x | | |
| Confirmation of non-compliant activitiy | | x | | |
| Identify liable person (e.g. registered keeper) | ? | x | | |
| Store legal evidence of non-compliant activity | | x | | |
| Inform liable person on non-compliant activity | ? | x | | |
| Claiming payment of non- or wrong paid toll | ? | x | | |
| Claiming payment of fines | ? | x | | |
| Enforce non-compliant activity | | x | | |

# 6. List of important documents and references


[1] CARDME 4 D4.1 The CARDME Concept

[2] CESARE II D022.1 Operational process definition

[3] CESARE II D022.2 External process definition

[4] CESARE II D022.3 Internal process definition

[5] CESARE II D022.4 Detailed analysis of potential roles of operators

[6] CESARE II D022.5 Report on legal and fiscal solution

[7] CESARE II D053.1 Synthesis of CESARE II MoU mapping process

[8] CESARE II D024.1 MoU agreement among TSPs

[9] CESARE II D024.2 MoU – Issuers Adhesion contract

[10] CESARE II D024.3 MoU – User contract

[11] PISTA D4.1 Interoperable EFC Common Service Definition

[12] PISTA D4.2 Basic contract clauses between users and issuers

[13] PISTA D4.3 Organisation and basic clauses for a MoU

[14] PISTA D4.4 Technical and IT requirements for a Common Service M.

[15] PISTA D4.5 Enforcement Methods

[16] MEDIA Final report

[17] NORITS Presentation & Paper Vienna September 2004

[18] IBTTA Summary Fall Workshop 2004

[19] WG1 N389 EFC System Architecture for Vehicle related Transport Services

[20] ENV ISO 17573 (for publication)

[21] Interoperability Directive 2004/52/EC (german/english/french/italian)

[22] Landwell study

[23] OMISS - Road User Charging Organisational, Functional, Process And Data Model For Interoperability – UK Department for Transport

# Annexes

# Annex A. Actors and entities of other models in CESARE EETS Model

This annex shall show that the CESARE EETS Model is very generic and the commonly used names for actors in other projects can be assigned to a CESARE EETS Role.

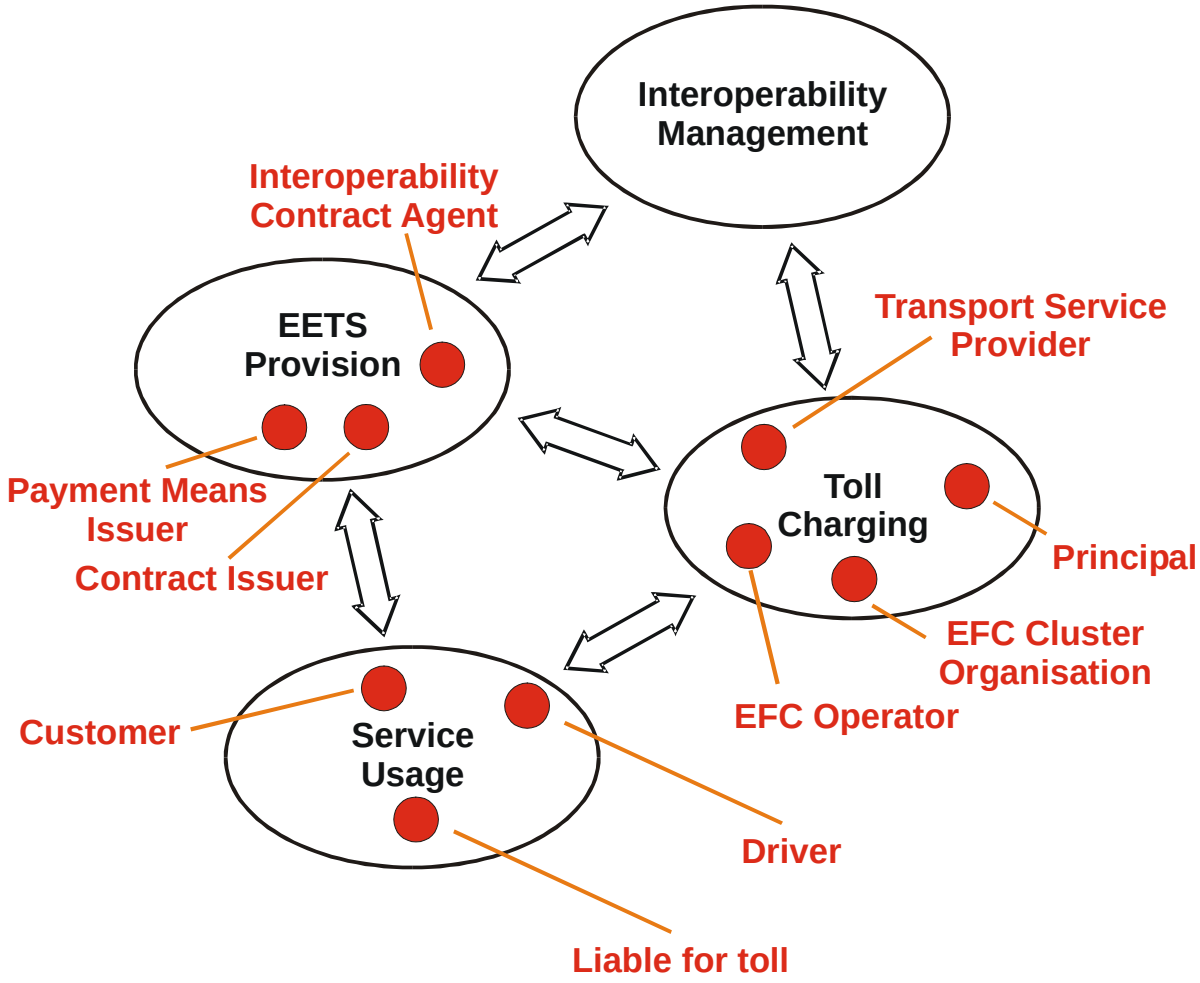


Figure 3: Possible actors within the CESARE EETS Roles

The figure shows a selection of potential actors of other projects. The relations between those actors is explicitly not shown in this figure as the arrangements are different from Role to Role (e.g. the relations within a Toll Charging Role in country A can be different to that in country B although the same actors are involved). The CESARE EETS Models takes that into account an allows different implementations within the Roles. It is important that each Role nominates one actor as representative for the interoperability functions (potentially different ones for different interoperability functions).

Following actors have been used in the figure above:

- **Transport Service Provider (TSP):** The actor that provides a transport service to the user (i.e. the road operator, road authority, the “owner” of the road infrastructure)
- **Principal:** The organisation or legal entity which is giving or defining the right of collecting toll. In legal terms the Principal can also be considered as the primary seller of the service.
- **EFC Operator (EFC):** The organisation that has the right to collect the toll and is operating the EFC infrastructure on behalf of a Transport Service Provider or Road Authority.
- **EFC Cluster:** The actor that is built by several EFC Operators in order to achieve a common EFC system (e.g. in interconnected networks)
- **Contract Issuer (CI):** The organisation that issues the service rights to the Service User, administers Service User and vehicle data. It may have a direct contractual relation with the Toll Chargers but may also use an Interoperability Contract Agent (see below) for that purpose.
- **Payment Means Issuer (PMI):** The organisation that collects the money from the Service User and handles the payment of services (e.g. credit or petrol card companies, banks)
- **Driver**: the driver of the vehicle in the toll domain
- **Customer:** the person who has signed the contract with the EETS Provider to use the EETS service
- **Liable for toll:** The person or organisation which is liable for toll payment. That can be the Service User or user as well.
- **Interoperability Contract Agent:** An entity that negotiates contracts with Toll Chargers and organises payment to them. It also will have contracts with several Contract Issuers which have in that case no direct contract with a Toll Charger. This is a possibility to reduce the number of necessary contractual relations and gives also smaller Contract Issuers the possibility to offer the interoperable service. It may also provide the technical equipment to the CI and will probably provide some other services (e.g. invoicing)

The following example shows possible contractual relations between and within two main Roles. This shall help to understand the proposal of the CESARE EETS Model and shall also show the diverse possibilities of organisational structures within the basic Roles. It shall underline the need for specification of the interface between the two main Roles in EFC: the Toll Charging and the EETS Provision.

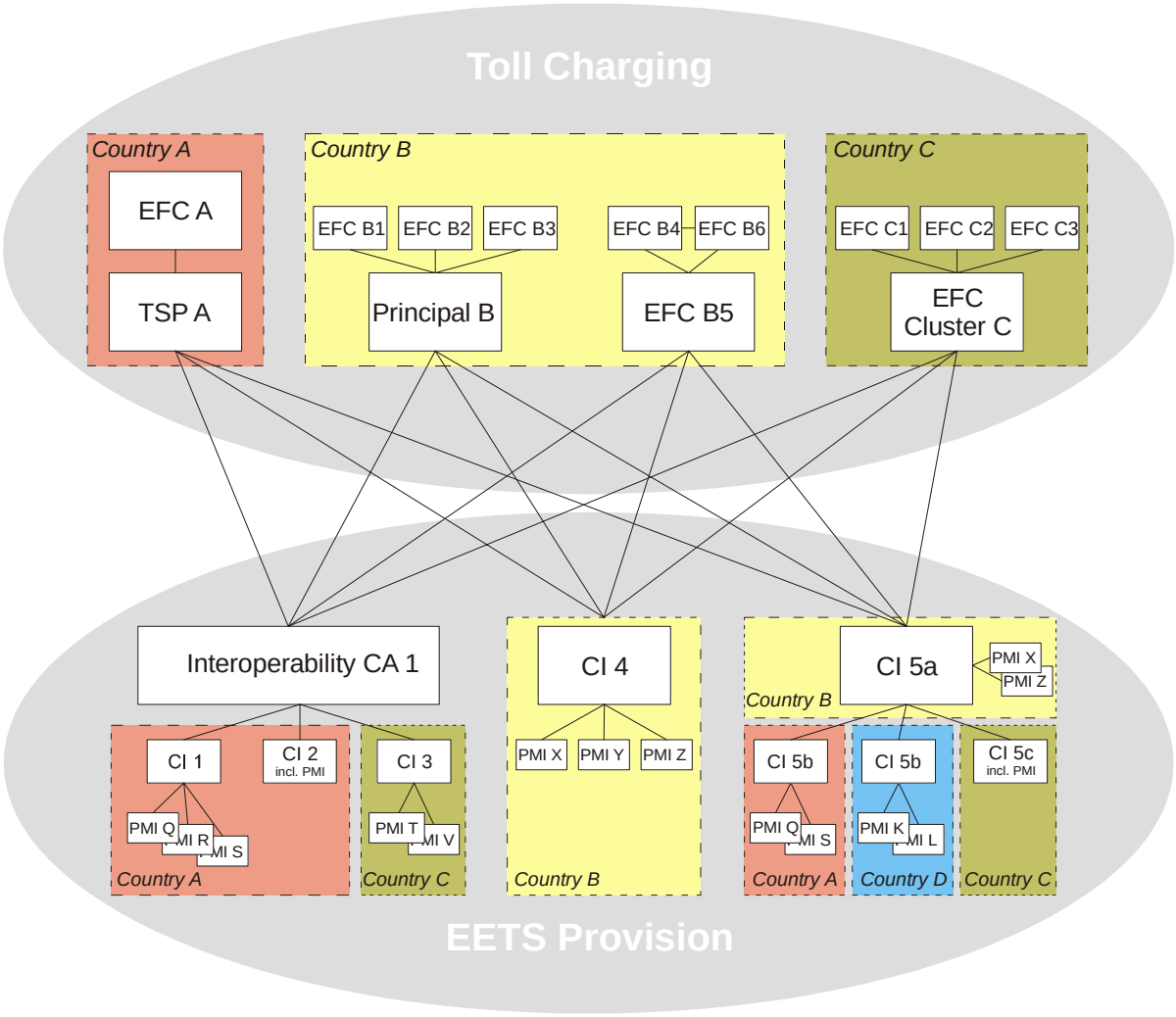


Figure 4: Possible contractual relations between and within the main EETS Roles

*CI= Contract Issuer, PMI =Payment Means Issuer, CA= Contract Agent,*

*EFC= EFC Operator, TSP=Transport Service Provider*

Some remarks to the example:

- In country A the Transport Service Provider (TSP) is having the contractual relation with the EETS Provision Role, while in country C the EFC Operator (EFC) Cluster Organisation takes this responsibility.
- In country B there are two toll domains. In one the Principal is the contractual partner of the EETS Provision Role, while in the other it is one EFC Operator authorised also by two other EFC Operators.
- The structure within the EETS Provision Role is in not country specific, but Contract Issuer (CI) normally issue their contracts under one national law (but to all EU nationalities). E.g. the CI5 is a

multi-national CI. It has branches in several countries. Only one branch is negotiating with the Toll Chargers, but offers the service via their national branches also in the other countries.

- The Contract Issuer 4 in country B has three Payment Means Issuer (PMI), i.e. the Service Users of CI4 can select the PMI.
- Some CI do not offer PMI, but offer these service by their own (CI 2 and CI 5c)
- The Interoperability Contract Agent (Interoperability CA) offers its services to CI in offering contracts in two countries.

The example shows contractual relations, data flows may use different channels or common data clearing centres.

# Annex B. General functional autonomous tolling architectures

## B.1 Introduction

For the evaluation of a future basic model for interoperability it is necessary that responsibilities of tolling functions can be clearly assigned to the relevant actors and services.
This can be easily done for DSRC architectures where all functions are well known and the responsibilities are already commonly accepted.
For interoperability with autonomous systems there is up to now no clear agreed functional architecture available. The new technologies allow the performing of tolling functions at different locations. The basic model shall allow different possible architectures for autonomous systems to be realised. A limitation on possibilities can be expected because of some high level requirements but the necessary extent shall be defined in the service definition in WP 2.

## B.2 Decomposition of autonomous tolling functions

### B.2.1 Autonomous tolling functions

Two aspects are important when decompose autonomous tolling functions.

- Location of data processing:
  - OBU
  - EETS Provider
  - Toll Charger
- Necessary input data, mainly:
  - Tolling application, including map
  - Tariff table
  - Sector info (where to send data from OBU)

Following main tolling functions for autonomous systems have been identified:

- **Collection of sensor data**
  A commonly agreed set of sensors delivers data which is used together with the stored declared characteristics as the main input for the processing of the sensor data.
- **Processing sensor data**
  Each autonomous Toll Charger has to define which sensor data[8] shall be used within its toll domain. It has to specify sensor data shall be processed in order to be able to determine the fee. This includes e.g. localisation and map matching of satellite positions to identify road sections or tolling areas as well as definition of events to be recorded.
  The definition of how to process the sensor data gives the Toll Charger the freedom to specify the data needed upon its needs and allows also defining redundancy checks which is required in most autonomous systems to reduce the enforcement need.
  This functions needs **data specific for each toll domain** (e.g. map, processing rules etc). These data have to be updated regularly or installed before first system entry.

[8] This does NOT apply for Toll Charger only using DSRC

- **Determine fee**
  According to the rules and the tariff table of the Toll Charger the results of the tolling application are processed to determine the fee due.
- **Produce tolling transaction**
  When the fee has been determined the final tolling transaction can be produced which is used for the claim from the Toll Charger to the EETS Provider.

The first function is by definition running on-board. The subsequent functions can be executed either on-board or centrally. If there are allocated centrally the data have to be transferred from the OBU to the central system of either the EETS Provider or directly to the on of the Toll Charger. If the OBU communicates directly with the Toll Charger the OBU has to know where the data shall be sent.

# Annex C. Existing interoperability models

## C.1 CESARE II

### C.1.1 Introduction

The CESARE II project aims at leading the toll road service providers (*i.e.* the motorway companies) to establish the contractual basis for an interoperable EFC service.

According to this interoperable service, each signatory Toll road Service Provider (TSP) will be committed to accept on its network all users being subscribers to the CESARE II service.

This CESARE II service allows the users:

- to quickly pass through toll barriers on interoperable networks, by using a single OBU accepted on all interoperable networks of the CESARE II project ;;
- to have the issuer as the single interlocutor for the whole invoicing process instead of having as many interlocutors as there are motorway operators involved ;
- to benefit from a monthly and single invoicing process (*i.e.* a brief statement of all the services provided with the group of all invoices, one invoice per involved operator or one invoice per country).

[It must be clearly pointed out the fact that the CESARE II service only deals with the method of payment of the tolls (i.e. a monthly invoicing instead of several invoices without any coherence) and has no connexion with the toll road service provided itself.]

### C.1.2 Architecture

Names of entities and roles

The three main entities involved are:

- the motorway operators (the TSPs), in charge of the toll road service provided ;
- the issuers, in charge of the payment method ;
- the users, who have subscribed to the additional service exclusively connected with the payment method (*i.e.* issuing the OBU and sending the invoices).

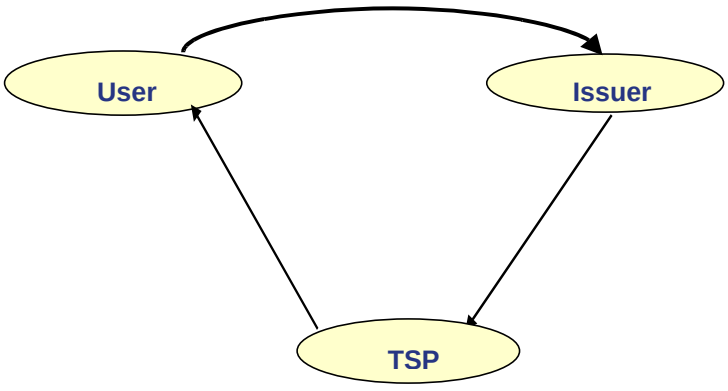


Figure 5: CESARE II organisational architecture

### 3.1.2.B. Contractual architecture

Three contractual levels have been identified:

- the contract between operators (also called MoU, *i.e.* Memorandum of Understanding or Joint Venture agreement between TSPs) ;
- the adhesion contract between operators and issuers ((also called CAPMI) ;
- the contract between issuers and users.

These three contracts have to be distinguished from the toll road service itself and are exclusively dedicated to an easier way to pay the tolls due to the operators.

Each of these contracts raises specific issues.

**(a)** The **agreement between operators** only concerns the operators.

This means that the signatory parties to this agreement are the motorway companies as operators and that no issuer is a party to this agreement.

The object of this agreement is that each operator agrees to install interoperable (*i.e.* compatible) equipments on its network, in order to be able to accept clients from an agreed issuer (*i.e.* an issuer who issues an OBU fitting the CESARE II technical requirements).

The agreement between operators could be:

- a contractual joint venture ;

or

- a corporate joint venture.

In order to avoid too heavy commitments that could dissuade some operators to join, the decision has been made to choose a contractual joint venture, without any prejudice for the future prospect of a corporate joint venture if later on requested by the motorway companies.

This decision has been integrated into the draft written by the legal and fiscal team for the agreement between operators.

To the contrary of a corporate joint venture, the main characteristic of a contractual joint venture is that there is no creation of a new legal entity.

Therefore, a committee composed of representatives of all operators manages the joint venture.

And, as a consequence of the contractual structure, decisions have to be approved unanimously, for example, in case of acceptance of a new operator.

It must be pointed out the fact that the CESARE II form MoU tempers the effects of the unanimity rule with the commitment of all signatory operators not to unreasonably deny their consent.

**(b)** The **agreement between operators and issuers** is devoted to give each issuer the role of setting up the key steps of the CESARE II system, which are, as exposed before:

- a single OBU ;
- a single interlocutor ;
- a single monthly invoicing process.

The **signatory parties** of the agreement between operators and issuers are:

- the motorway companies as operators, on one hand,

and

- the issuers, on the other hand.

This includes a functional and, maybe, an organic distinction between operators and issuers.
The object of the agreement between operators and issuers is to transfer from the operators to the issuers the responsibility of:

- issuing OBUs,
- monthly sending the invoices to the users,
- collecting the tolls from the users

The definition of the issuer's tasks raises several questions relative to the legal qualification of the relationship between operators and issuers.

These question have been one of the main issues because, as a rule, the sharing of responsibilities (that is the guarantee for the insolvency risk, *i.e.* unpaid accounts) depends on the legal qualification of the relationship between operators and issuers.

**(i)** In case of **invoicing for third party account**:

- the issuer sends the invoice to the users in the name and on behalf of the operator, *i.e.* the issuer is acting as a transparent mandatory agent ;
- the system of sharing of responsibilities (guarantee for the insolvency risk, *i.e.* unpaid accounts) is totally flexible, *i.e*. it is up to the negotiation between operator and issuer to decide if the issuer will take full or partial responsibility for the insolvency risk (and, of course, it is also up to the negotiation between operator and issuer to fix the payment due for this service).

**(ii)** In case **the issuer acts on its own name**:

If the issuer acts on its own name, the operation will, therefore, consist in **reselling the toll road service** or **buying the accounts receivable** (*i.e.* the right to recover the due tolls) for the toll road service. Therefore, the issuer is fully responsible for the insolvency risk.

**(c)** The **contract between users and issuers** includes:

- Service User and vehicle details ;
- general terms and conditions ;

- OBU handling instructions ;
- Payment means details.

Each issuer shall develop its own form contract to be undersigned by the user. The operators shall indicate a minimum set of clauses to be included in such contracts in order to guarantee themselves on the correct use of the EFC service.

### C.1.3 Current Status

The CESARE II has been used as a set of basic items for an interoperable system, particularly for the PISTA Project.

## C.2 PISTA

### C.2.1 Introduction

TSPs from five different European countries (Spain, France, Greece, Denmark and Portugal) participated on the PISTA project which was co-financed by the European Commission.

PISTA was a demonstration project with the objective to achieve an implementation of a new interoperable Electronic Toll Collection system under real traffic conditions in several pilot sites belonging to concessionaries from the various countries involved.

The project was divided in two main parts: The first one was focused on the system definition under three different approaches:

- The technical interoperability: ensuring systems compatibility at European level by defining the technical requirements for new ETC equipment and detailing all the technical specifications.
- The product interoperability: offering the users the same product regardless of their origin and current concessionary and giving the same services to the user.
- The business interoperability: detailing the relationships between the different participants of the ETC system in a MoU (Memorandum of Understanding) to provide a common ground to handle contractual and monetary issues and implementing an organization for the transfer of funds and data.

The second part consisted in demonstrating that the ETC system defined by the consortium works properly under real traffic conditions. For this purpose, the participants tested ETC equipment form seven different manufacturers on several motorways. The tests were performed on predefined extreme conditions and on real traffic conditions. At the end, 621.536 transactions were performed by 89.395 different users

### C.2.2 Architecture

**Names of main actors and roles**

- Motorway operator: a company or other type of organisation, which is in charge of the maintenance and operation of a toll motorway concession.
- EFC Operator: entity that is responsible for collecting the transit data at the EFC lanes.

- Transport Service Provider: actor that plays the role of both the motorway operator and the EFC operator.
- User: a person or an organisation that uses the transport service provided by a road operator / TSP according to the terms of contract expressed by the payment means.
- Issuer: a financial company or other type of organisation, which issues a card or OBE to a user and guarantees the payments made with that card or OBE.
- Acquirer or Bank Merchant: a financial company which acts between TSPs and issuers, receiving from the TSPs the EFC transactions and then settling them with the issuing banks.
- Payment Means: the expression of a contract between the user and the issuer that allows the user to access the services available in the payment system.
- Cluster ETC Organisation: refers to organisations developed in several European countries (TIS in France, Via-T in Spain or Via Verde in Portugal) with the aim to exploit a national EFC system.

**Functional and contractual architecture**

The ETC System defined in PISTA assumes the coexistence of cluster ETC Organisations with a European ETC Organisation. That is, the implementation of a European ETC MoU Organisation does not imply the replacement of the current Cluster EFC Organisations.

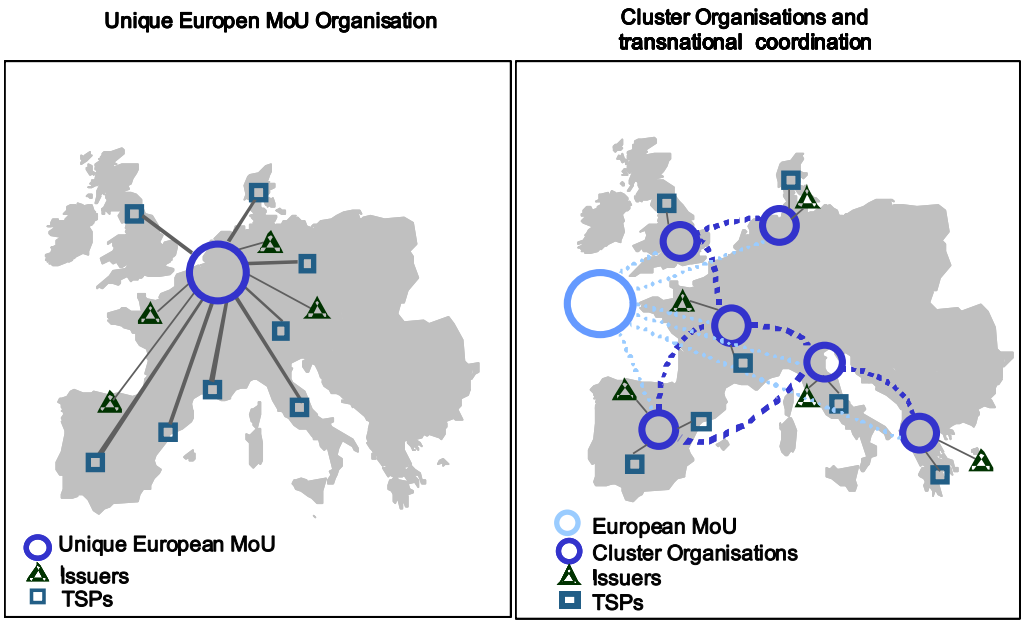


Figure 6: PISTA Co-existence of ETC Cluster Organisation and European ETC Organisation

The main responsibility of the European MoU Organisation is to define the common elements that make possible the interoperability between TSPs of different countries.

Usually, the main task of a Cluster ETC Organisation is to contribute to the implementation of an ETC System managing payment means and operating funds and data exchange.

Once the common ETC System is developed, the MoU Organisation could be formed by Committees with the support of an administrative unit.

Main characteristics of the Committees are:

- Committees are formed by representatives of the TSPs.
- Each Committee carries out some specific functions: for example, the Technical Committee is in charge of the Technical Management of the common ETC System.
- Committee members act part time: the Committees meet periodically or they are constituted to carry out some specific activities.

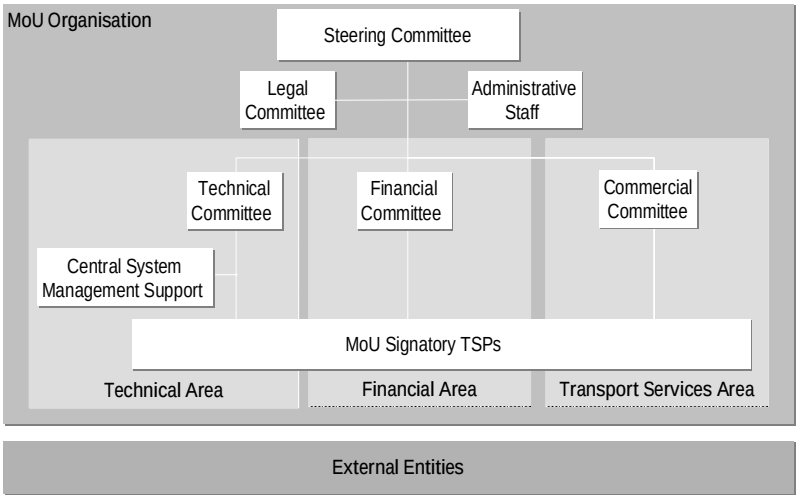


Figure 7: PISTA organisational architecture

**Contractual architecture**

The PISTA project uses the basis of the CESARE II model: Three contracts levels have been identified:

- The Memorandum of Understanding between TSPs: A formal agreement is required to establish the main rules necessary to manage and implement the common ETC System as well as to rule the main relationships to be set up between the TSPs. The object of this MoU is that each TSP undertakes the task to implement and achieve a technical, procedural and contractual common organisation in order to accomplish and achieve an interoperable EFC System all over the toll road network managed by all of the signatory TSPs.

  PISTA members consider that the legal structure most suitable for the interoperable ETC system is a contractual joint venture. It must be pointed out that by virtue of the contractual nature of the joint venture between the TSPs; the decision-making process is governed by the unanimity rule.

- The contract between TSPs and Issuers: is required to establish the main rules that are necessary to manage and implement the adhesion of the Issuers to the common ETC System, as well as to rule the main relationships to be set up between TSPs and Issuers. The object of this contract is that the Signatory TSP agrees to accept the payment means issued by the Signatory Issuer, which will be

used by the Users for the payment of the tolls due for the transits performed throughout the toll road network managed by the Signatory TSP.

- The contract between the Issuer and the User is required to establish the services provided to the User by the Issuer and the main conditions binding the use of the OBE. The object of this contract is to entitle the User to use the OBE according to the terms and conditions specified in the contract itself.

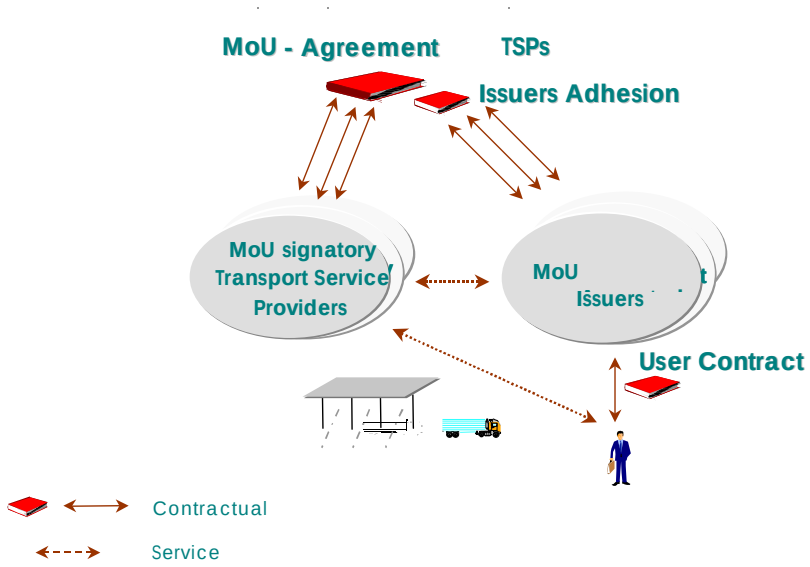


Figure 8: PISTA contractual architecture

### C.2.3 Current Status

The PISTA project took place from January 2002 to October 2004. The ETC system defined in PISTA was implemented in Spain under the name of VIA-T and it is the basis of other current systems implemented by the European Northern countries and the new system implemented in Portugal.

## C.3 MEDIA

### C.3.1 Introduction

MEDIA stands for “Management of EFC DSRC Interoperability in Alpine Region”. It is an interoperability initiative of tolling operators from the Alpine countries Austria, France, Italy, Slovenia and Switzerland. MEDIA has the objective to find and implement a concrete solution to enable that tolls for heavy vehicles in the participating fee collection systems can be paid electronically and in an interoperable way.
MEDIA builds on existing foundations and especially uses material from the projects CESARE, PISTA and CARDME. In the definition of the MEDIA solutions, possible extensions to other countries and system types are envisaged and taken into account.
All five involved Alpine countries have electronic fee collection systems installed which employ microwave DSRC technology. It is the common vision of the partners to create a new contractual product for their Service Users. The product shall enable that:

- tolling fees for heavy vehicles can be paid electronically at all participating operators
- Service Users shall have a single contract and receive a single payment statement

MEDIA will not define a single technical product, but a set of requirements. Any product or mix of products that fulfils the MEDIA requirements is acceptable as a technical basis for the service. This might, for example, be a combination of two on-board units that reside side-by-side at the windscreen.
In MEDIA, every Service User has a contract with a service company, named the Contract Issuer. For all aspects of paying tolls or fees in the participating systems, the Contract Issuer is the single point of contact for the user. The Contract Issuer prepares the on-board equipment with the required vehicle, payment and security data and delivers it to the Service User.
The Contract Issuer pays to the toll system operators on behalf of the Service User, giving the system operators a payment guarantee. Finally, the Service User receives from the Contract Issuer a single statement, or invoice, for all tolls and fees in the various systems, including a service fee for the Contract Issuer’s services. MEDIA is managed and controlled by the MEDIA Association, the association of the core participating tolling system operators.

### C.3.2 Architecture

The following actors are defined for the MEDIA project:

**Transport Service Provider (TSP):** The organisation that provides a transport service to the user (i.e. the road operator)

**EFC Operator:** The organisation that has the right to collect the toll and is operating the EFC infrastructure, for the account of the TSP.

**Contract Issuer (CI):** The organisation that issues the service rights to the Service User, administers Service User and vehicle data, is responsible to make the OBEs available to the Service User and organises payment to the EFC Operators.

**Payment Service Provider (PSP):** The organisation that collects the money from the Service User and handles the payment of services (e.g. credit or petrol card companies, banks).

**Service User:** Haulier who has signed the contract with the Contract Issuer

**User:** The driver of the vehicle is the person that directly "uses" the service and directly interacts with the OBE. Driving through the tolling stations, he has to understand the various signals that the OBE and the tolling stations send him. He has to make settings in the OBE when he changes his trailer, when he enters or leaves a country, etc.

**MEDIA OBE:** One device or a set of devices that allow the electronic payment of fees in all MEDIA EFC systems using the same contract and the same payment means.

The contractual architecture of MEDIA consists of 3 main documents, the MEDIA Association Statutes, the MEDIA Service Charta and the bilateral contracts between the EFC Operators and the Contract Issuers.

**MEDIA Association Statutes**

The MEDIA Association is a co-operation between MEDIA EFC-Operators. The association is an autonomous body without own commercial activities. The MEDIA Association Statutes define the regulatory level of MEDIA.

The objective of the MEDIA Association is to design, implement and operate an EFC service for heavy vehicles (>3.5t) in the networks of the participating members.

The Implementation and operation of the MEDIA Service requires a common body in order to co-ordinate the MEDIA Service on the technical and organisational level, as well as to (re-) define the MEDIA Service Charta.

The MEDIA Association consist of selected MEDIA EFC Operators. There is no obligation for MEDIA EFC Operators to participate in the MEDIA Association. MEDIA EFC Operators that want to enter the MEDIA Association have to be accepted by it.

The MEDIA Association defines a set of minimum required functionalities and technical specifications for OBE as well as for roadside equipment and data exchange. The minimum is defined by the need to implement the MEDIA Service in all participating systems (one contract, one invoice).

The MEDIA Association is defining the MEDIA Service in the MEDIA Service Charta.

Proposals for changes or adaptations by members of the MEDIA Service Charta have to be directed to the MEDIA Association.

The MEDIA Association can redefine in particular:

- the EFC Operators with whom the CI have to conclude a Bilateral Contract to become/stay MEDIA Contract Issuer (new, leaving or excluded MEDIA Service members)
- the service level a CI has to guarantee to become/stay MEDIA Contract Issuer

**MEDIA Service Charta**

The MEDIA Service Charta is a legally binding agreement in the form of a contractual framework between the MEDIA EFC Operators and the MEDIA Contract Issuers that provides technical, procedural and contractual interoperability of Electronic Fee Collection.

The MEDIA Service Charta:

- determines the legal relationships and mutual obligations of the parties in order to achieve the MEDIA Service,
- defines the conditions for Contract Issuers and EFC Operators to become MEDIA qualified,
- defines the rules for Contract- and OBE issuing to the Service Users,

- defines the rules for the MEDIA EFC Service, the general rules for data and information exchange between the EFC Operators and the Contract Issuers,
- defines how the payment is ensured to the EFC Operators by the Contract Issuer,
- defines the roles and the structure of the MEDIA Association and the financial contribution to the Common Service that are due by all its members,
- defines some elements regarding the contracts between Contract Issuers and Service Users
- requires the signature of additional bilateral agreements.

IMPORTANT: The MEDIA Service Charta will NOT determine any obligations among the EFC Operators and also not among the Contract Issuers.

**Bilateral Contracts**

The MEDIA bilateral agreements are signed between the EFC Operator and the Contract Issuer for issues which can't be covered with the MEDIA Statutes or Service Charta. The bilateral contracts

- determine the specific context between EFC-Operators and Contract Issuers
- specify the remuneration of the Contract Issuer (e.g. commission, fees, etc.)
- specify details of data exchange (e.g. frequency)
- refer to annexes such as the MEDIA Service Charta, functional and operational specifications etc.
- shall be signed in parallel with the MEDIA Service Charta

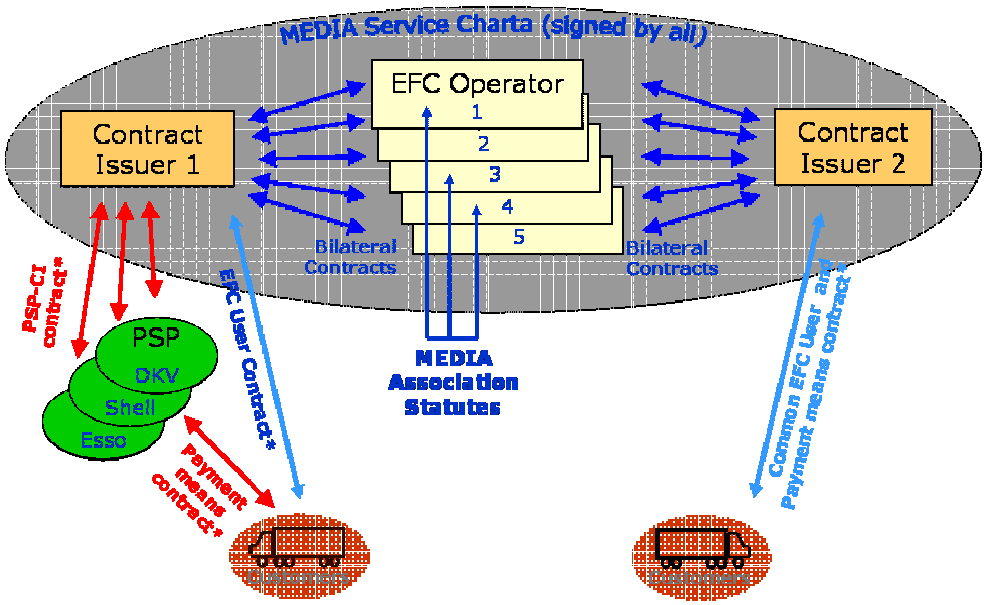


Figure 9: MEDIA contractual architecture (*= contracts not defined in MEDIA)

### C.3.3 Current Status

The participating operators ASFINAG, Group APRR, Autostrade per l'Italia, DARS and OZD intend to introduce the MEDIA service as quickly as possible, ideally by beginning 2007. The MEDIA Steering Committee will decide in October about the go-ahead of the project.

## C.4 OMISS

### C.4.1 Introduction

As part of the UK Department for Transport's (DfT's) ongoing research into road charging, it established the DIRECTS (Demonstration of Interoperable Road user End-to-end Charging and Telematics Systems) Project to explicitly showcase interoperability of systems from a number of manufacturers. As part of the contract there was a requirement upon the contractor (the Fareway Alliance) to prepare draft specifications that the DfT would issue as OMISS (Open Minimum Interoperability Specification Suite). The key aim was that OMISS, in part or in whole, would form the Interoperability Requirements for inclusion in the procurement specifications for any charging schemes to be implemented by any road Authority.

The core of the project was built around the UK's business model for road charging systems (ref [20]), itself set in the context where local authorities had been empowered by the Transport Act 2000 to introduce congestion charging schemes. Fundamentally, it was recognized that with little in the way of legacy systems (apart from a limited number of tolled crossings where only a few were using an electronic charging techniques) there was the opportunity to start with a 'clean sheet'. The potential for a large number of schemes that could be procured separately highlighted that interoperability requirements had to be driven from the centre and an approach was endorsed that would deliver a single on-board unit per vehicle linked to a single account in the longer term. In addition, it was recognized early that it was economically inefficient for each new scheme to create its own back office system to process users' bills and that this could be achieved more effectively through appointing or franchising a limited number of organisations to undertake this across the community of UK users. Lastly, there was a need to ensure that travel privacy was offered as a key component of the system by separating the physical data associated with transactions from the account related data, and to this end an explicit, 'not for profit' entity referred to as a Data Clearing Operator was created. The other advantage of such an organization is that in an environment where many separate schemes could exist, along with a number of billing organizations, that the contractual framework for road charging could be simplified by all parties contracting with the Data Clearer, rather than through a myriad of bi-lateral agreements.

The OMISS material will comprise three key documents:

- Volume 1 – "System Description": covering the business model, key functions and business processes. Volume 1 Annexes: Entity descriptions describing the functional and performance requirements of each element within the business model and end-to-end systems performance requirements.
- Volume 2 – "RUC Interface Specification": covering the data flows between relevant pairs of entities in the business model
- Volume 3 – "Requirements For OBU To RSE Transactions Using 5.8GHz DSRC" (focused on off-board accounts only) and it companion test specification document: "Evaluation of Conformity of OBU and RSE to the Transaction Requirements using 5.8 GHz DSRC". [Currently in the public domain]

Although the DIRECTS project has investigated 5.8GHz microwave systems in both off-board and on-board account modes, for OMISS, the focus has been upon specifying off-board account approaches as the technology to support on-board charging is not sufficiently mature (speed of operations is too slow to meet security overheads associated with e-money and stored value approaches on smartcards). In addition, the project has investigated charging using GPS / GSM devices for zone, cordon, virtual gantry and grid charging. Requirements for such systems have not been documented in OMISS as there are currently no

clear operational requirements for real systems in the UK that would use such technologies. The scheme concepts that could be defined and implemented using GSP / GSM techniques are so broad that it is not worthwhile to specify requirements for such systems at this stage.

### C.4.2 Architecture

The following actors are defined for OMISS:

**OBU:** A device that allows the electronic payment of fees in all OMISS compliant systems using the same contract

**RSE:** The equipment necessary to capture data about traffic passing specific points or using roads within a defined area. This includes DSRC beacons and enforcement cameras and may also incorporate independent classification systems

**Highway Authority or Private Road Owner:** The organisation that owns the road in a particular area and hence provides the transport service to the user

**On-Road Services Provider (ORSP):** The organisation that provides the RSE or related equipment for the charging system within a defined geographic boundary on behalf of the relevant Highway Authority

**Payment Services Provider (PSP):** The organisation that issues the service rights to the User, administers Service User and vehicle data, is responsible for making OBUs available to Users. This service can be provided nationally (or potentially internationally)

**OBU Issuer:** An organisation that may be subcontracted by a PSP to ensure the correct issue and possibly installation of each OBU to a nominated vehicle

**Data Clearing Operator:** A single not for profit organisation that receives charging data and image data from ORSPs for onward transmission to the relevant PSPs looking after each User's account.

**National Enforcement Agency**: An organisation that may be created in the future should local and inter-urban charging become widespread in the UK. ***Details of scope and role have yet to be clarified.***

**User:** Private individual or company that has signed the contract with the PSP. The User is the registered keeper of the vehicle as recorded in the database of the Driver and Vehicle Licensing Agency (DVLA) and is legally responsible for any road charges irrespective of whether he or she is the driver of the vehicle.

**Trusted Third Party:** The organisation that manages the issuing of security keys, whether for OBU and RSE communications or for the exchange of data between organisations within the business model.

**Fraud Detector:** An organisation that receives transaction related data from all key organisations within the system (i.e. ORSPs, DCO and PSPs) and has the capability to mine data for individual or corporate fraudulent activity.

**DVLA:** The government organisation in the UK that has responsibility for recording the ownership of vehicles.

**NRA/I:** The organisation responsible for the issuing of manufacturer and PSP codes to ensure the unique numbering of OBUs. This function is currently performed by DfT in the UK.

**National Regulation:** Some form of national oversight and control of electronic charging schemes. ***Details of scope and role have yet to be clarified.***

The current business model is shown below:

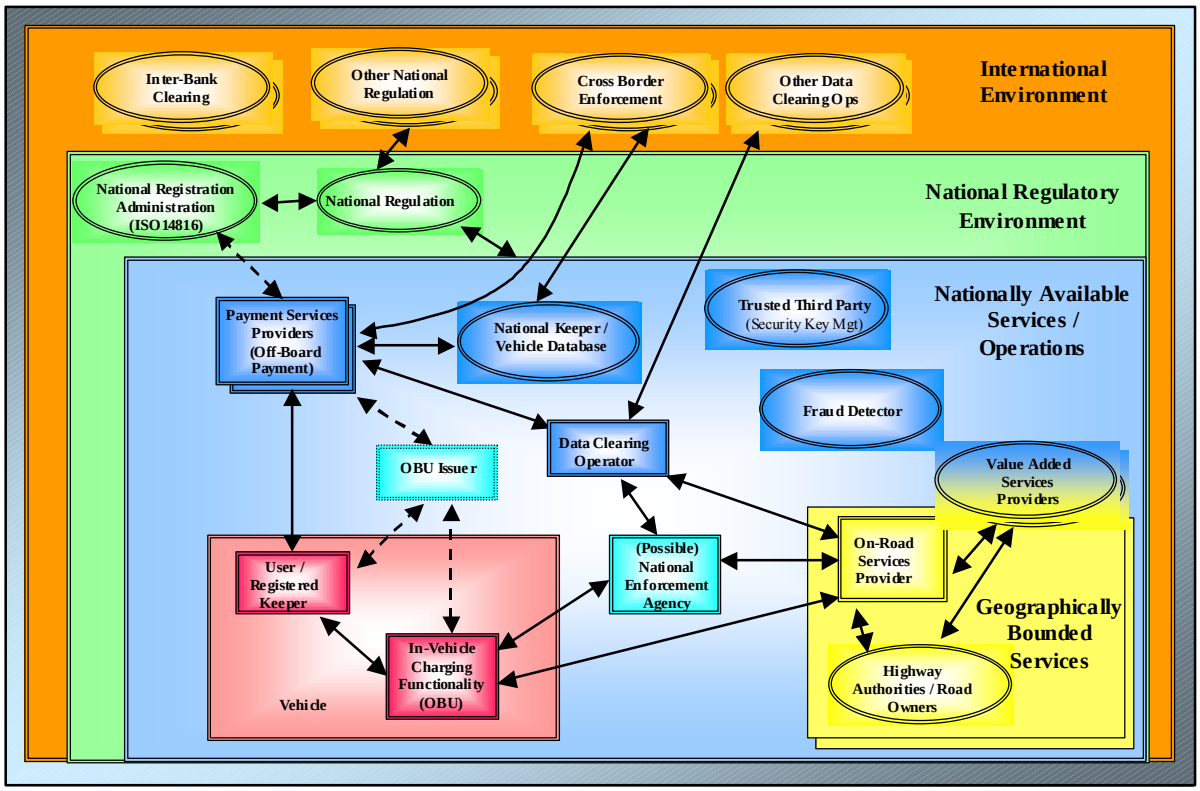


Figure 10: OMISS contractual architecture

### C.4.3 Current Status

Volumes 1 and 2 of the OMISS documentation are currently being drafted. Volume 3 and its accompanying conformance specification were issued in July 2005 and are available from DfT on the Departmental web Site URL:

- http://www.dft.gov.uk/stellent/groups/dft_control/documents/contentservertemplate/dft_index.hcst?n=14687&l=2.

It is intended that following the internal review of the new OMISS documents and the incorporation of any necessary amendments that these will be made available for wider comment.

## C.5 NORITS

### C.5.1 Introduction

Architecture NORITS is a joint initiative between road authorities and toll road operators in the 4 Nordic countries; Denmark (DK), Finland (SF), Norway (NO) and Sweden (S). The 4 partners involved in the project are

Figure 11: The partners in NORITS

Norvegfinans (organisation of Norwegian toll road operators) and the Finnish Ministry of Transport take part as observers in the project group.

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 already received from his local issuer / toll operator. The NORITS service will be available from 2006 and includes toll operators and some ferry companies. Other types of transport providers like parking company's may join later. All the current operators in Scandinavia are using the DSRC-based EFC.

### C.5.2 Architecture

**Names of main actors and roles:**

Issuer: The company that issues contracts (and distribute OBUs) that enables the user to pay with an OBU in the EFC-lanes at the NORITS operators.

Operator: The operator of the individual toll station / toll system.

User: A person or an organisation which have signed a contract with the issuer allowing him to pay with an OBU in the EFC-lanes at the NORITS operators.

**Functional and contractual architecture:**

The overall architecture of NORITS is illustrated in figure 2 below.

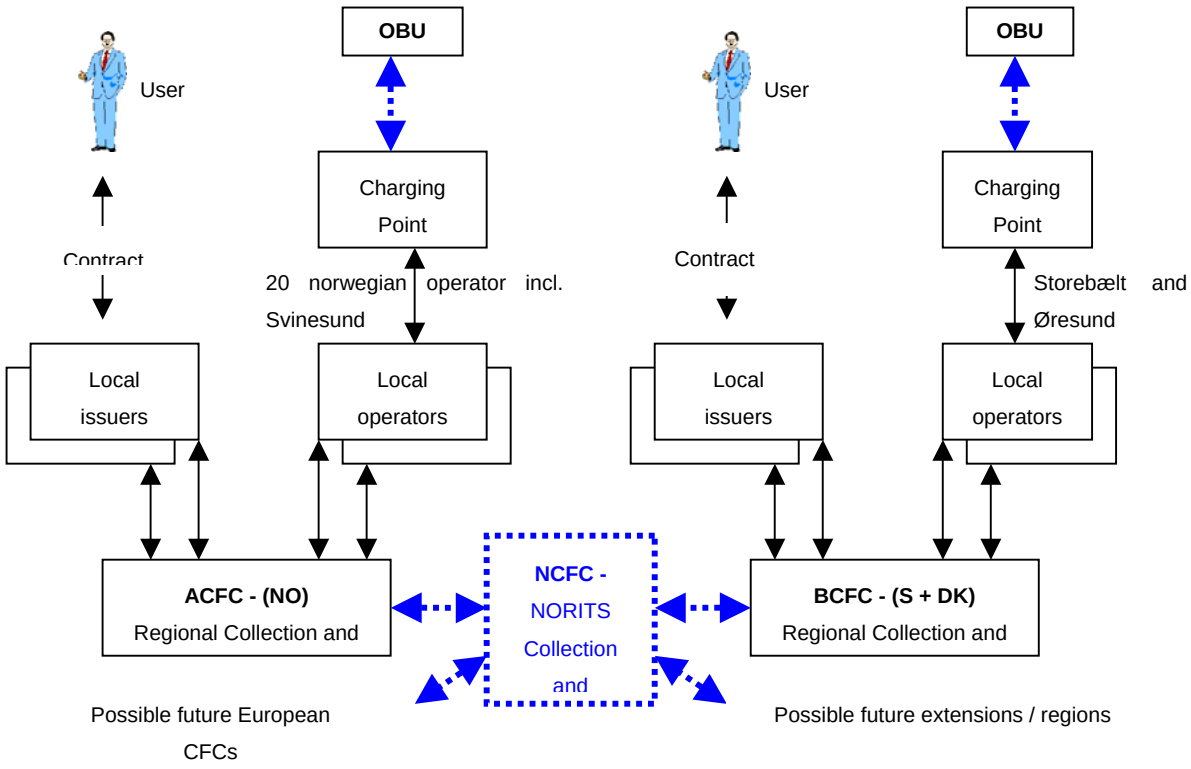


Figure 12: NORITS architecture

Explanations:

AutoPASS: The EFC-system used in Norway (NO).

BroBizz: The EFC-system used at Storebælt and Øresund.

NCFC: Collection and Forwarding Central – NORITS; Central for the collection and distribution of data between the regions in NORITS.

ACFC: Collection and Forwarding Central – A; Regional central for the collection and distribution of data between regional issuers /operators in region A (Norway) and other regions in NORITS.

BCFC: Collection and Forwarding Central – B; Regional central for the collection and distribution of data between regional issuers /operators in region B (Storebælt and Øresund) and other regions in NORITS.

The ACFC is already in operation in Norway and more than 20 operators ( / issuers) are connected to this central including the new Svinesund project. The BCFC has been implemented in co-operation between Sweden and Denmark. The two projects Storebælt and Øresund and some ferry companies are connected to NORITS via the BCFC and local clearing between these companies will be done by the BCFC. All local central systems and charging points must be upgraded to be able to communicate in accordance with the NORITS interfaces and procedures.

The NORITS specification describes the following three elements (shown in blue dotted lines):

- Common functionality (NCFC)
- Interfaces when connecting to the NCFC
- Interface between OBU and Charging Point

There are a few principles that are important to observe:

- All operators, issuers and regional CFCs that will be a part of NORITS, must implement the interfaces included in the NORITS-specification
- Clearing between issuers and operators is done bilaterally. The collection and forwarding centrals are only forwarding data and do not include clearing functionality.
- Clearing between issuers and operators in the same region is carried out locally, and data is forwarded through the regional CFC. No data is distributed via the NCFC
- In the illustration above, issuers and operators are two separate actors. Today most toll operators are also issuers of their own OBUs. The specification is however made general to allow for a development where some operators choose not to issue OBUs (example Svinesund) or the role of issuing OBUs is handled by separate actors.

The operational organisation is illustrated below:

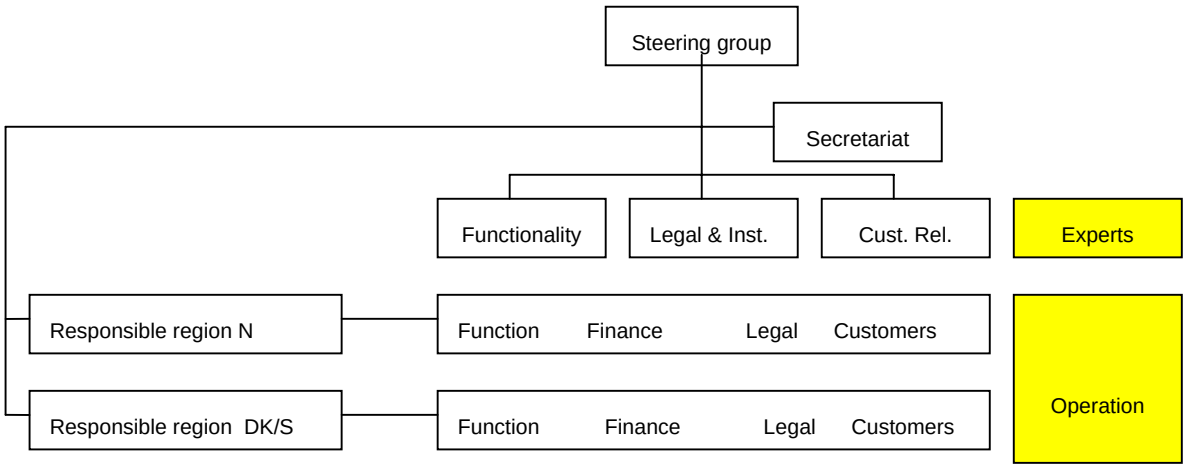


Figure 13: NORITS operational organisation

The steering group is responsible for the following tasks:

- Administration and evaluation of the operation of NORITS
- Responsibility for the development of technical systems
- Responsibility for development of the NORITS concept
- Manage and decide on applications and terminations of participation in NORITS

- External communication concerning general NORITS topics
- Financial control of NORITS including follow-up on cost-models
- Legal and institutional issues

The expert-and the operation group will handle the day-to-day business as well as the development of NORITS. The responsibilities are divided into the following areas:

- Technology
- Legislation and contractual topics
- Service User relations
- Internal administration
- Implementation of new (types of) participants
- Reporting

The responsible for the two regions Norway and Denmark/Sweden manages the daily operation and the reporting of this to the steering group and should manage the running co-operation between the regions.

**Contractual architecture:**

The CESARE II model is used for the basis of the NORITS project. Experience from the national interoperability implementation of CESARE-2 in AutoPASS in Norway has as been incorporated in the final set of agreements.

NORITS operates with the following agreements:

- Joint Venture Agreement

  The operators taking part in NORITS signs an agreement, which states the conditions of the cooperation. This agreement is referred to as the Joint Venture Agreement (JVA) and includes a number of appendices:

  1. Description of the network
  2. Common Service Definition including procedures for issuers and operators, procedures for collection and forwarding data and Currency selection procedures,
  3. Technical requirements including Data format and interface specification, requirements to CPE and requirements to collection and forwarding systems.
  4. Definition of the Support Organisation
  5. Budget and agreed contribution quotas

- Issuer agreement

  All companies issuing payment means accepted by NORITS operators must sign an issuer agreement with the NORITS operators. The agreement includes a number of appendices:

  1. Description of the network
  2. Common Service Definition including procedures for Service User relations, procedures for issuers and operators, procedures for collection and forwarding data, Currency selection procedures and Invoicing procedures
  3. Technical requirements including Data format and interface specification, requirements to CPE and requirements to collection and forwarding systems.
  4. Payment Means
  5. Minimum set of clauses of the agreement to be entered into among the Issuer and each User

6. Fee to be paid between operator and issuer

- User agreement
  New paragraphs must be added in the issuer's contract with the individual user describing the conditions under which the user can use his OBU as payment means in all NORITS facilities

### C.5.3 Current Status

The project was started in 2004 as the result of a of a feasibility study. Current status (October 2005) is the following:

- Technical specifications was finalized early 2005
- Technical implementation is nearly finalized
- Tests are ongoing
- Contracts are expected to be signed late this year.
- The service will be available in 2006.

## C.6 Austria – Switzerland

### C.6.1 Introduction

The Swiss-Austrian interoperability was the first international one between national EFC systems. It is in operation since the start of the Austrian system (1.1.2004).

### C.6.2 Architecture

The main architectural details are:

- Unilateral interoperability:
  The Swiss TRIPON can be used in Austria to pay the fee. The Austrian GO-Box cannot be used in Switzerland to register the LSVA because it does not have the basic technical requirements to operate in a system based on tachograph, GPS and DSRC.

- Technical interoperability:
  - The DSRC board of the Swiss TRIPON is used to perform a toll transaction with the Austrian beacons.
  - Mainly the Vehicle Registration Number and the trailer declaration are read out with the transaction.
  - A declaration of a trailer in the TRIPON corresponds to the charging of class 4 (4 axles) fee in any case (also in case of a total number of 3 – 2+1- axles)
  - No receipts are written into the TRIPON.

- No contractual interoperability:
  The user needs to sign a separate contract in the Austrian system. This special TRIPON contract is established through EUROPPASS contact points (internet, call centre) by declaration of the vehicles Registration Number and the number of axles of the vehicle (without trailer).

- Needed adaptations:
  - The Swiss LSVA Transaction (CEN Standard) was implemented in the Austrian beacons.
  - No software adaptations were needed for the TRIPON: only a contract-bit is set using a chipcard send to the user by the Swiss customs authority after registration at EUROPPASS.
  - Software adaptations to processes and software in the Austrian and Swiss central systems were needed.

### C.6.3 Current Status

There are currently more than 2700 HGV vehicles registered in the Austrian tolling system using the Swiss Tripon OBU.

## C.7 Via-T and VIA Verde (Spain-Portugal)

Spain and Portugal are committed to reach in mid 2006 the full interoperability between their national ETC systems: VIA-T and VIA VERDE.

After the efforts made by Portuguese toll roads to migrate their antennas to CEN 278, both systems are now technically compatible and so the main issue remains on the business model definition and on the contractual issues.

Both parties have agreed to respect the principle of reciprocity meaning that all the VIA-T OBUs are going to be accepted by Portuguese TSPs and, on the other side, VIA VERDE OBUs will be accepted by Spanish TSPs

In Spain, there are two kinds of OBU issuers with their own particularities: banks and saving banks which use the financial circuits (belonging to EURO 6000, 4B and SERVIRED) for clearing ETC transactions and the petrol companies which directly deal with the TSPs buying the transits performed by their clients.

On the other hand, in Portugal the company VIA VERDE acts as issuer of OBUs and as clearer of the ETC transactions through a financial corporation named SIBS.

The model accepted will be based on agreements among national clearing centres (VIA VERDE in one side and EURO 6000, 4B and SERVIRED in the other) as far as financial issuers are concerned. In order to also guarantee the interoperability to the OBUs issued in Spain by petrol companies (which clients are generally the HGV) the model foresees that VIA VERDE will also reach agreements with the main Spanish petrol companies which should act as representative of the other companies operating in Spain.

The success of this project is based on the efforts made by Portugal on upgrading its technology and on the fact that there is a real market for the interoperability. A key factor is that all actors involved in the scheme have been taken into account of the design of the new model despite their different natures.

## C.8 France (New TIS poids lourds)

### C.8.1 Introduction

The French motorway companies have decided to implement an interoperable electronic toll collection system dedicated to HGVs, and to put it in operation in the second half of 2006.

This Project comes within the scope of the EC Directive n°2004/52/CE of 29 April 2004, which lies the basis of a European electronic toll collection system.

The distinction must be made between:

- the motorway service, *i.e.* the public service the motorway companies are in charge of, and with which particular commercial conditions can be combined, in order to apply rebates to the standard toll rate ;
- the interoperable service, delivered to the clients by the issuer and which only deals with the method of payment.

### C.8.2 Architecture

**Name of entities and roles**

The implementation of the TIS-PL interoperable electronic toll collection system implies three different groups of players:

- the motorway companies (*i.e.* operators), which are in charge of the motorway public service, *i.e.* the operation and maintenance of the toll motorway network;
- the issuers, in charge of the payment method, *i.e.* contracting with the users, distributing OBUs, collecting the transit data produced by the motorway companies and managing the single invoicing process; apart a small number of issuers which will be subsidiaries of the French motorway companies, it is intended that issuers are entities legally independent of the motorway companies;
- the users, who have subscribed to the interoperable service.

**Contractual architecture**

Therefore, the contractual architecture is as follows:

1. a memorandum of understanding signed by all motorway companies;
2. several bilateral contracts between each motorway company and each issuer;
3. all contracts between each issuer and its own clients.

**1.** The MoU between motorway companies is a corporate joint venture agreement.

This means that there is no creation of a new legal body.

All signatory parties are motorway companies which commit to install interoperable on their network, in order to be able to accept and recognize clients from an agreed issuer (*i.e.* an issuer who issues on-board units fitting the TIS-PL technical requirements).

**2.** The second contractual level is composed of several bilateral contracts between each motorway company and each issuer.

According to these contracts, the operators will accept on their networks the OBUs issued by the issuers, and will empower the issuers to :

- invoice the clients for the tolls,
- collect the tolls from the clients.

The issuers is also in charge of the insolvency risk.

For these services provided to the operator and to the client, the contribution due to the issuer is:

- partly paid by the operator (as a fee due for the invoicing process managed on its behalf and for the insolvency risk);
- partly paid by the client for the provision of the interoperable service.

It must be pointed out that in France the reselling model is not possible for legal reasons. However, though the invoices are issued in any case on the account of the operator, they may be issued in the name of the operator (*i.e.* the issuer is a transparent agent) or in the name of the issuer (*i.e.* the issuer is an opaque agent), the choice will being left to the issuer.

Therefore, the issuer will collect:

- on the account of the operator : the tolls for the motorway service provided by the operators;
- on its own account: the price for the interoperable service he has provided to the clients.

The operators keep all responsibilities regarding the toll rate fixing and the definition of reduced price programs.

In case reduced prices are linked to a special subscription, the issuers will be empowered by the operators to propose this subscription to their clients, in order they could benefit from reduced prices. But this subscription is only proposed to the clients by the issuer on behalf and in the name of the operator.

This means that at the same time issuers are invoicing for the operators account (*i.e.* on behalf of the operators, but not necessarily in their name), they are also allowed to commercialize subscription programs that may allow the clients to benefit from reduced prices on the motorway service.

The issuer is both:

- agent of the operators for the toll invoicing process (either transparent agent or opaque agent);
- transparent agent for the commercialization of subscription programs that may allow the clients to benefit from reduced prices on the motorway service.

**3.** At the third contractual level, the client will sign a contract with the issuer in order to be provided with the interoperable service.

At the same time, the client will also have the opportunity to subscribe to a reduced prices program proposed by the operator through the issuer.

Therefore, as well as the client is provided by the operator with the motorway service, he may also contract:

- with the issuer for the interoperable service
- with the operator (through) the issuer for the reduced prices program.

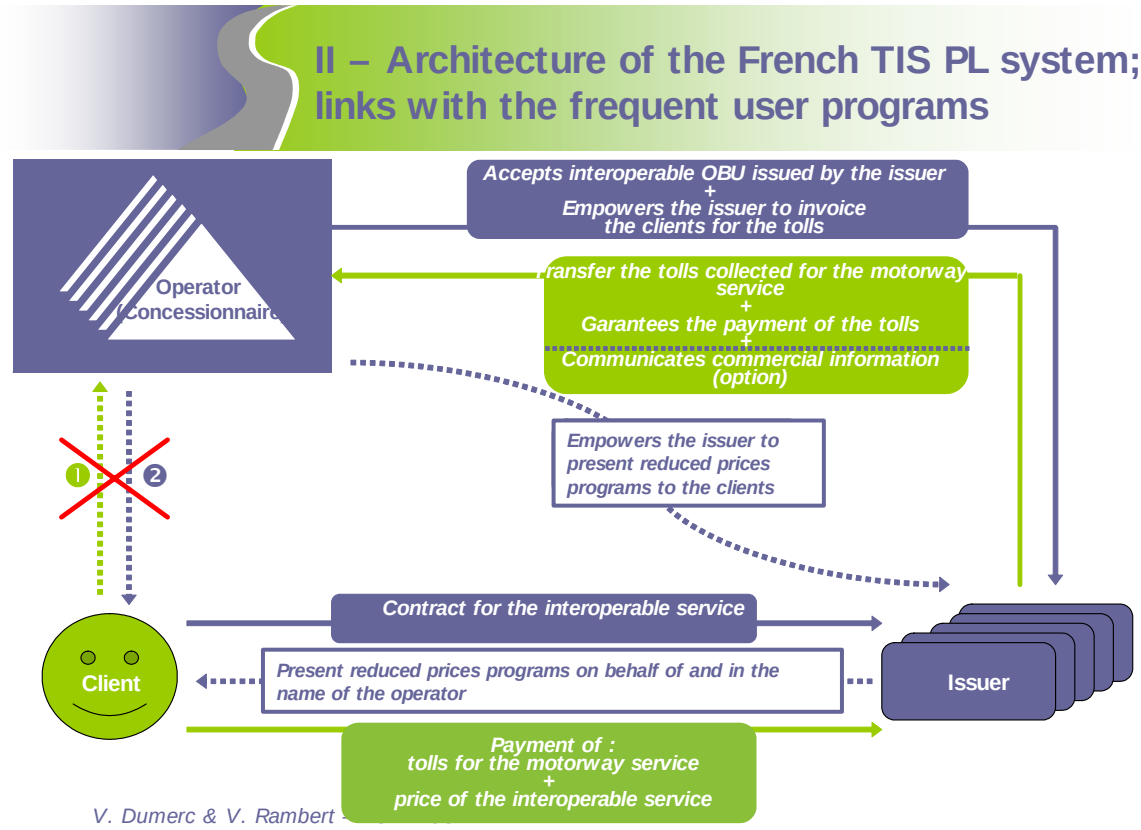


Figure 14: Architecture of French TIS PL system

### C.8.3 Current status

The MoU between the motorway companies has been signed in September 2005.

## C.9 Telecom Model

### C.9.1 Introduction

The Mobile telecoms market is also engaged in providing ease of cross border interoperability for their client's mobile telephones through delivering devices which use commonly agreed operating software and user applications.

The provision of one invoice per month to the subscriber billed at the home country BTW rate for both domestic and cross border calls is made possible through a re-selling model devised amongst the Telecoms operators.

### C.9.2 Architecture

Names of main actors and roles:

1. Network operators: operating GSM masts etc
2. Service providers: Issuing SIM-cards to their users.

A network operator may also act as a service provider.

Some service providers are not network operators themselves.

Functional and contractual architecture

- A service provider sells "calls" to its Service Users.
- A Network operator sells "calls" to the service provider.
- Roaming contracts are between Network operators.
- Network operators sell "calls" to each other.
- The only cross-border contractual relationship existing is that between the Network operators.

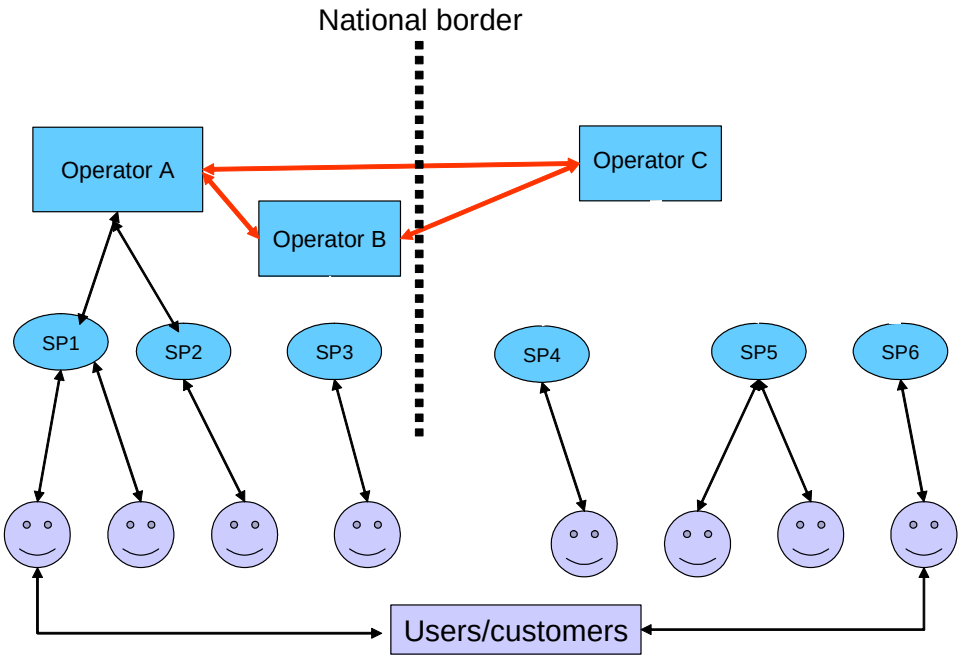


Figure 15: Mobile Telecom model

### C.9.3 Current Status

This solution may be difficult to replicate unless certain EU countries permit this sort of model (Reselling model) in the tolling environment. The contractual relationship between the National Telecoms Operators and the local service providers does however provide a potential basis for the cross border relationships as envisaged in the CESARE III business model.

## C.10 Credit Card Model

### C.10.1 Introduction

The credit card model could also be of relevance to the EFC Interoperability model. The user of a credit card can pay with its card in various places throughout the world, getting a single invoice/statement every month for the purchases done. Credit cards are interoperable within various payment systems, transactions and payments are sent from one issuer to another charger.

### C.10.2 Architecture

Following roles and actors can be found in the credit card model:

**Cardholders:** Consumers who use credit card as a payment mean for their purchases

**Merchants:** Sellers that accept credit cards as a payment mean; they are usually paid in good funds within 48 hours

**Issuers:** They provide the credit card to the cardholders. They earn revenues from consumers and acquirers

**Acquirers:** They earn revenues from merchant by bilaterally setting merchant discount rates and pay interchange fees to issuers

**Visa/ Mastercard network:** The network is comprised of member banks that can be issuers, acquirers or both. It:

- sets the interchange fees, which are paid by acquirers to issuers.
- is comprised of member banks that can be issuers, acquirers or both.

For the most part, Visa operates as a non-profit organization and until recently MasterCard had a similar structure.

The main purpose of these organizations is to meet the needs of their members by providing a set of rules, underlying infrastructure, and some level of research and development to improve their networks. Some of these rules govern the setting of interchange fees, no-surcharge rules, and the acceptance of branded products.

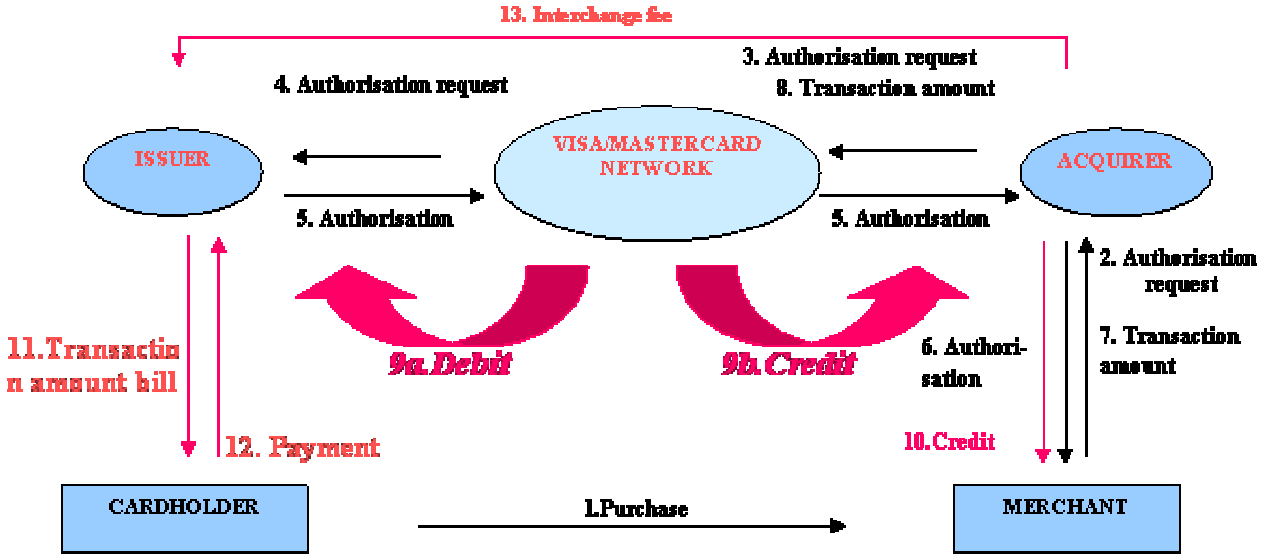


Figure 16: Credit card model model

The functional architecture can be described as follows:

1. The cardholder makes a purchase at a merchant
2. The merchant sends authorization request to the acquirer bank
3. The acquirer bank sends an authorization request to Visa
4. Visa forwards the request to the issuer bank
5. The issuer bank sends its response via Visa to the acquirer bank
6. The acquirer bank forwards the response to the merchant
7. The merchant sends the transaction amount to the acquirer bank
8. The acquirer bank submits the transaction amount to Visa for settlement
9. a/b Visa debits the issuer bank and credits the acquirer bank
10. The acquirer bank credits the merchant
11. The issuer bank bills the transaction amount to the cardholder statement
12. The cardholder pays the bill
13. A interchange fee is levied

### C.10.3 Current Status

The credit card model is highly successful and widely in use.

## C.11 Other projects

### C.11.1 The Dutch 'Kilometre Charging' project

Under the Dutch 'Kilometre Charging' toll regime all vehicles were required to pay a tax for the use of the public Dutch road network. Initially vehicles should pay a flat rate per kilometre which was different for HGV's and private cars. In a second phase the toll might became place and time depended.

The charge was completely calculated by the onboard equipment. Once a month or per 1000 km a declaration of the total amount was automatically send via a 'service provider' (issuer) to the tax authorities. The 'service provider' then issued an invoice on the name of tax authorities to the user. The invoice had to paid directly to the tax office.

The issuer was encouraged to implement also other additional services on the OBE.

The OBE also produced a detailed journey overview which could only be accessed by the user. This detailed overview contains a 'toll detail record' for e.g. every kilometre or every minute driven by the vehicle. For privacy reasons the detailed journey overview was not (!) send to the service provider and, as a consequence, not tot the tax authorities.

Enforcement was accomplished by monitoring the production of 'toll detail records' by means of a trusted SIM-card. The SIM-card performed a number of consistency checks on the consecutive records, retained a copy of the last few records and calculated a hash-code over all records per declaration period. The SIM card signed every declaration made by the OBE after the inclusion of security data. This resulted in three enforcement instruments:

- Irregularities in the sequence of toll detail records were reported by the SIM card in the next declaration
- The last few toll detailed records could be read securely form the SIM card with mobile or roadside equipment and checked on its validity. In case of suspicion the vehicle could be stopped or the user could be asked to show the complete detailed journey overview.
- A user could be asked, e.g. at random or in case of suspicion, to show his complete detailed journey overview to the authorities.

# Annex D. Detailed list of functions

*The list of functions is an input to WP2 and will be further developed in WP2..*

| Function name \ Responsibility of Basic Role Lifecycle | EETS Provision | Toll Charging | Service Usage | Interoperability Management |
|---|---|---|---|---|
| **Set-up and maintain service definition** | | | | X |

The common EFC service has to be defined by an entity within the Interoperability Management Role. The EETS Provider and Toll Chargers can be involved in that definition process.
It includes a definition how vehicles can be classified, e.g. not a common classification scheme will be applied, but a common set of classification parameters has to be agreed in the service definition.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Set-up and maintain OBE/RSE/CS test specification** | | | | X |

All technical equipment relevant for interoperability has to be specified. An equipment is relevant if either it communicates with another system compontent from another main actor or it has to fulfill certain requirements for data acquisition, storage and access (authenticity, security etc).
Beside of On-Board equipment and Road Side Equipment also certain parts (hardware, applications) of the Central systems of the EETS Providers may be specified.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Set-up and maintain common contract terms definition** | | | | X |

Some contract terms to be used in the contracts between Toll Chagrer and EETS Providers as well as between the EETS Providers and the Service Users have to be in common resp. will require a minimum or maximum defintion.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Set-up and maintain data exchange specifications** | | | | X |

The data exchange between a lot of parties is easier, if the parties agree on a common data exchange specification. It is less required if the data exchange is bilaterally.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Set-up Interoperability Management Organisation** | | | | X |

If there is a need for organisations resp- entites to execute IM tasks, these entities have to be founded.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Set-up Security / Key entity** | | | | X |

A common security requires an accepted security entity(s) which issues keys.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Set-up Dispute Management and resolve disputes** | | | | X |

As the EETS is mandatory each Toll Charger has to conclude a contract with each EETS Provider. A EETS Provider can only offer the EETS to its Service Users if it finds commercial agreements with all Toll Chargers. Disputes between parties have ot be solved or the soultion has to be supported by an organisation within the Interoperability Management Role.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Certify OBE/RSE/CS** | | | | X |

The technical equipment which is specified (On-Board Equipment, Road Side Equipment or Central System parts) has to be certified by organisations acknowledged by all interoperability participants.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Monitor OBU/Contract ID schemes** | | | | X |

The OBU/Contract-ID schemes of each EETS Provider resp. of their suppliers has to be monitored.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Monitor service operations (monitor EETS Provider/Charging)** | | | | X |

Some quality parameters may be included in the service defintion . These can be monitored actively by a commonly agreed organisation or only in case of disputes between the interoperability participants.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Promote service** | X | X | | X |

The EETS has to be promoted.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Issue list of valid contracts providers (EETS Provider White List)** | | | | X |

In order to know with which EETS Providers have to be accepted (i.e. and commercial and procedural negotiations have to be started), the Toll Chargers need an official information on who is qualified to become EETS Provider. Probably some quality parameters are defined in the service defintion to become potential EETS Provider.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Accept service definition** | X | X | | |

For the EETS all Toll Chargers and all EETS Providers have to accept the service defintion. This may be implicitly by concluding a contract with cross-reference to the EETS service defintion or by directly accept the EETS service defintion.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Set-up commercial contracts** | X | X | | |

In the relation between a Toll Charger and an EETS Provider commercial details have to be agreed (e.g. comissions, data exchange frequencies, payment procedures etc). Altough there is a common EETS

defintion, it is expected that not all commercial details can be fixed and agreed in common. The commission normally is dependent on the payment procedure and the type of service. Therefire it is expected that some commercial details will be only agreed on the bilateral level.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Set-up data exchange network** | X | X | | ? |

For the data exchange between a Toll Charger and an EETS Provider a data exchange network has to be set-up. As both actors are interested in a limited number of data exchnage interfaces, it is expeced that a certain standardisation will take place. If common data exchange facilities will be set-up it may well be that the Interoperability Management Role will participate in the responsibilites (and the financing).

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Set-up distribution network (OBE/contracts)** | X | | | |

The EETS Provider has to set-up a distribution network to issue OBE eventually to the user.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Set-up user support / help desk** | X | | | |

An EETS Provider is regarded as the first point of contact for its Service Users in case user support is needed. It will be obliged to operate a user support help desk. To a certain degree a Toll Charger has to provide some help to the EETS Provider or even under some conditions to the user when he is in the toll domain of a Toll Charger.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Set-up issuing and payment services** | X | | | |

The EETS Provider has to set-up a service to issue the contracts to the users.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Install / adapt ETTS equipment (CS/distribution network)** | X | | | |

The EETS Provider has to install EETS capable equipment in its central system and in its distribution network.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Issue contract to user** | X | | | |

An EETS Provider has to issue an EETS contract to the Service User. This may also be an extension of an existing contract. The EETS Provider is free in its commercial possibilities. In the EETS definition some common contract terms are specified which have to be included in the contracts (e.g. required behaviour in Toll Charger systems etc.)

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Accept payment means of user** | X | | | |

The EETS Provider has to accept a payment mean of the user.

| | EP | TC | SU | IM |
|---|---|---|---|---|

| Inform Service User user generally on service | X | X | | ? |
|---|---|---|---|---|

A Service User has to be informed on the service.
Next to the common contract terms there has to be documentation available by the EETS Provider to a Service User on the different Toll Charger systems, especially on the correct behaviour and required manual actions in each Toll Charger system.
Additionaly also a Toll Charger has to provide information on its system to the Service Users within its toll domain, eventually supported by the Interoprabitliy Management.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Acquire vehicle registration information** | X | | | |

An EETS Provider has to acquire vehicle registration information. Eventually some quality requirements are set-up for this function (i.e. an EETS Provider has to read out the information from a (copy of an) offical document. In sytems with declared characteristics it can be already part of the tolling security to define certain requirements how to acquire the data.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Acquire user information** | | | | X |

An EETS Provider has to collect data also on the Service User and eventually also on possible persons liable to the toll (e.g. registered vehicle keeper which is not necessarily the Service User).

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Personalise OBE** | X | | | |

Some Toll Charger systems require declared characteristics (e.g. classification parameters, number plate). Therefore the OBE has to be personalised with the vehicle/Service User data).

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Initial database (map, tariffs) in OBE** | X | | | |

Depending on the architecture of the autonomous application on the OBE it may be that a maps and tariffs of some Toll Chargers have to be installed initially.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Make certified OBE available** | X | ? | X | |

A Service User has to have EETS-certified OBE installed in its vehicle. This has either to be issued by the EETS Provider, some other institutions or some Toll Chargers (e.g. OBU already used in a Toll Charger domain).

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Install and mount OBE** | ? | | ? | |

The OBE has to be installed in the vehicles. It may be that the installation can not be done by the user itself for a EETS OBE.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Modify contract** | X | | X | |

A Service User may alter some contract data (liable person, classification data, emission class etc).

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Modify payment means** | X | | X | |

A Service User may alter its payment means.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Modify OBE data** | | | | X |

An EETS Provider has to alter the personalised OBE if the user has altered relevant data (e.g. numberplate, emission class)

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Update map, tariffs** | ? | ? | ? | ? |

The toll domains of Toll Chargers are not fix, e.g. new roads will become toll roads and tariffs will change. While in DSRC systems this is leads to no problems, this is a major responsibility issue for autonomous systems.
An autonomous Toll Charger will either directly issue altered maps to OBE or send it via the EETS Providers.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Cancel contract** | X | | | |

Each EETS contract of a Service User of an EETS Provider can be cancelled. The EETS Provider is responsible to either black list the OBE of this Service User or to withdraw the OBE.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Issue Black list to Toll Chargers** | X | | | |

The EETS Providers have to issue a black list of Service Users (e.g. PAN, OBU-ID) to the Toll Chargers for those Service Users for whom they will not guarantee the payment.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Issue Security elements to Toll Chargers** | X | | | |

In order to allow the Toll Chargers to check the authenticity of an OBU.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Set-up tariff and tolling structure** | | X | | |

Each Toll Charger has to define its own tolling and tariff structure.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Install EFC equipment (CS/RSE)** | | X | | |

A Toll Charger has to install EETS certified EFC equipment on the road side and in the central system.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Set-up central system and payment services** | | X | | |

A Toll Charger has to implement the necessary functions in its central system to introduce the EETS.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Distribute keys in EFC system** | | X | | |

The keys to authenticate the OBU have to be ditributed in the Toll Charger networks.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Issue definition of processing of sensor data** | ? | X | | ? |

An **autonomus** Toll Charger has to define the processes to run on the EETS OBE and which (sensor) data have to be used in its toll domain. It has to be defined who is responsible for the definition, implemtation (especially if direct up-load on the EETS OBE) and operation of the processing.
This includes e.g. localisation and map matching of satellite positions to identify road sections or tolling areas as well as definition of events to be recorded.
The definition of how to process the sensor data gives a Toll Charger the freedom to specify the data needed upon its needs and allows also defining redundancy checks.
This function needs **data specific for each toll domain** (e.g. map, processing rules etc). These data have to be updated regularly or installed before first system entry.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Issue "roaming" details** | | X | | |

An **autnomous** Toll Charger has to inform the EETS Provider or the EETS OBE in or close to its toll domain (probably via a central node) where to the OBU or the EETS Provider has to send the tolling data.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Declare variable parameters** | | | X | |

A Service User is obiged to declare in some toll domains certain variable parameters (e.g. number of axles, trailer).

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Collection of sensor data** | X | | | |

A commonly agreed set of sensors delivers data which is used together with the stored declared characteristics as the main input for the tolling application.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Inform user on OBE status** | X | | | |

An OBE has to inform the Service User on the current OBE status. A malfunction has either to be communicated to the Service User either directly (e.g. visual “not ok-light” or indirectly (e.g. not showing the visual “ok-light” for certain events). In some toll domains (mainly free flow) the user is legally obliged to check its OBE on proper function.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Inform user on tolling obligation when entering/leaving road** | | X | | |

A Service User has to be informed visually that he is entering or leaving a toll road network or area. This is not an interoperability issue as it applies also to non-EETS users.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Inform user on correct lane use** | | X | | |

If a Service User has to use a special lane this has to be indicated on the lane. Closed lanes and speed restrictions have to be clearly signed.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Perform tolling communication (DSRC)** | X | X | | |

If passing a DSRC beacon the tolling communication is performed, triggered by the road side equipment (RSE) of a Toll Charger. The RSE selects the correct contract (if more than one is stored on board).

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Security check (DSRC)** | | X | | |

Together with the performing of the tolling communication the RSE performs a security check. The RSE checks the authenticity of the OBE, black lists etc. while the OBE may check the access credentials of the RSE.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Calculate fee (DSRC)** | | X | | |

The calculation of the fee can be performed either together with the perfroming of the tolling communication (i.e. the fee can be part of the communication) or seperatly (i.e. the fee can not be part of the communication)

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Store tolling transaction (DSRC)** | X | X | | |

The tolling transaction (the communicated data including the calculated fee) is stored in the central system of the Toll Charger

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Inform user about performance results (DSRC)** | ? | X | | |

The user can be informed about the result of the DSRC passage immediatly. The RSE can trigger a signal on the OBE (e.g. 4 beeps if the communcation was not succesful).

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Process sensor data (GNSS)** | X | ? | | |

The sensor data collected are be processed according to the specified rules of a Toll Charger. This function can be performed on-board, centrally at the EETS central system or at the central system of a Toll Charger. As this function needs to have toll domain specific data the actual allocation is very important in relation with the data exchange.
If the processing is done off-board the OBU is not able to indicate to the driver if he is driving on a toll road and he will not be able to judge if the processing is delivering the correct results.

| | EP | TC | SU | IM |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| **Determine fee (GNSS)** | **?** | **?** | | |

With the results of the processing of the sensor data the fee can be determined. This function can be performed on-board, centrally at the EETS central system or at the central system of a Toll Charger. As this function needs to have toll domain specific data the actual allocation is very important in relation with the data exchange.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Inform Service User about sensor processing results (GNSS)** | | | | **X** |

The user can be informed about the result of the processing of the senor data. This is not possible if the processing is done off-board, at least not in real time. The processed sensor data may be made available on another way to the user (e.g. internet).

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Store tolling transaction (GNSS)** | **?** | **X** | | |

The processed senor data and the determined fee can be seen as the equivalent product as on the DSRC side. A Toll Charger has to store the tolling transaction in its central system. A EETS Provider may also store (part of) the tolling transaction in its central system (depending on the allocation of the functions adn the used way of data communication).

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Claim payment from EETS Provider** | | **X** | | |

A Toll Charger can claim money for all genuine tolling transactions stored in its central system.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Issue invoice to EETS Provider or user (or invoice elements)** | | **X** | | |

A Toll Charger will issue an invoice to an EETS Provider for all tolling transactions of its Service Users in a certain time period (reselling) or will issue invoice elements to an EETS Provider to allow a issueing of invoices by the EETS Provider to the Service Users on behalf of a Toll Charger (non-reselling).

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Give assistance in case of user complaints on performed transactions** | | | | |

A Toll Charger has to give assistance to an EETS Provider in case of user complaints on tolling transactions (e.g. access to further data)

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Give assistance in case of operational user complaints** | | | | **X** |

A Toll Charger has to give assistance to the EETS Provider in case of operational user complaints (e.g. investigations on events).

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Receive claims from Toll Charger** | **X** | | | **X** |

An EETS Provider has to receive the claims of a Toll Charger

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Check claims** | X | | | |

An EETS Provider will check the authenticity of these claims and deny them if there are not genuine.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Pay Toll Charger** | X | | | |

If the claims are genuine the EETS Provider will pay the Toll Charger.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Settle user account** | X | | | |

Most probably via a Payment Means issuer, not relevant for interoperability.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Issue invoice to Service User** | X | | | |

A Service User will receive an invoice from its EETS Provider for the services used. Either directly (reselling) or on behalf of the Toll Charger (non-reselling). Especially commercial users are interested to claim back the VAT paid in each country.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Issue itemised transaction list upon Service User request** | X | | | |

A Service User shall have the possibility to view all tolling transactions (they may be summarised in the invoice). This can be offered e.g. by internet.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Inform Service User about account status and account events** | X | | | |

Not relevant of r interoperability

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Receive Service User complaints on charged transactions** | X | | | |

The EETS Provider as first point of contact to the user has to receive the user complaints on charged tolling transactions.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Inquiry on complaints on charged transactions** | X | | ? | |

First of all an EETS Provider has to investigate on complaints. In some governmental systems it is only liable person which can ask for further inquiries. Probably the Service User can authorise its EETS Provider to inquire at a Toll Charger on his behalf.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Inform Service User about result of inquiry on complaints** | X | ? | | |

A Service User user will be informed by the EETS Provider on the result and consequences of the complaint inquiry.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Receive operational Service User complaints** | X | | | |

An EETS Provider as first point of contact to the user has to receive the user complaints on charged tolling transactions.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Inquiry on operational Service User complaints** | X | | | |

First of all the EETS Provider has to investigate on complaints.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Inform Service User on solving operational user complaints** | X | | | |

A Service User will be informed by its EETS Provider on the result and consequences of the complaint inquiry.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Handle OBU according to requirements** | | | X | |

A Service User has certain obligations in the operation of its EETS OBU, at least in some toll domains (e.g. check functionality before driving on toll network, enter number of axles etc.).

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Pay account/invoice** | | | X | |

A Service User as to pay the EETS Provider for the services consumed. Not relevant for interoperabiltiy

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Contact help desk** | | | X | |

The first point of contact of a Service User is its EETS Provider.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Detect vehicle on tolled road** | | X | | |

The frist step in an enforcment process is to detect a liable vehicle on the road.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Identify tolling transaction or correct functioning of OBU** | | X | | |

If a liable vehicle is detected on the road it can be checked with EETS users if a tolling transactions has been produced, if the correct variable and fixed parameters are set and/or if the OBU is correct functioning (in autonomous systems with off-board processing only the correct functioning and the correct setting of the parameters can be checked).

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Check Black List** | | X | | |

The Black List of a Toll Charger can be checked (including the black lists of the EETS Providers).

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Determine (potential) non-compliant activities** | ? | X | | |

A Toll Charger can determine non-compliant activities by comparing the data measured on the road and receiving by communication. In autonomous systems the processing of the sensor data may also indicate some non-compliant activities (defined by the Toll Charger).

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Capture legal evidence of non-compliant activity** | | X | | |

For non-complinat activities a Toll Charger has to collect legal evidence. This is normally a picture of the road-side situation. In autonomous systems it may include additional data received from the OBE.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Confirmation of non-compliant activity** | | X | | |

Automatic detected non-compliant activities are normally verified by the staff of the Toll Charger (e.g. comparing the picture with the measured and declared data).

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Identify Service User (i.e. liable person - e.g. registered keeper)** | ? | X | | |

A Toll Charger has to identify the liable person in order to enforce the non-compliant activity. For liable person out of the toll domain this can be impossible (in some countries for all users).
An EETS Provider may assits in this process for those users having used an OBE registered at the EETS Provider.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Store legal evidence of non-compliant activity** | | X | | |

A Toll Charger has to store the legal evidence according to the national rules (and to delete the evidence according to the national rules)

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Inform Service User on non-compliant activity** | ? | X | | |

A Toll Charger has to inform the Service User on the non-compliant activity.
An EETS Provider can support this funcition by informing its (if identified as such) Service User on the existing of a non-compliant activity at a Toll Charger.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Claiming payment of non- or wrong paid toll** | **?** | **X** | | |

A Toll Charger has to claim the wrong or non paid toll from the liable person. An EETS Provider may support this function. It can be seen as additional service for its Service User which allows the Service User to clarify the non-compliant activity in order not to meet any troubles when visiting the toll domain of the Toll Charger the next time.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Claiming payment of fines** | **?** | **X** | | |

A Toll Charger has to claim the fine from the liable person. An EETS Provider may support this function. It can be seen as additional service for its Service User which allows the Service User to clarify the non-compliant activity in order not to meet any troubles when visiting the toll domain of the Toll Charger the next time.

| | EP | TC | SU | IM |
|---|---|---|---|---|
| **Enforce non-compliant activity** | | **X** | | |

A Toll Charger has to try to enforce each non-compliant activity. In the legal situation of today it seems that an EETS Provider can not assist in the final enforcement of the non-compliant activity.

# Annex E. Description of new toll systems

## E.1 GO Maut Austria

### E.1.1 Tolled infrastructure and vehicles subject to toll

All motorways are tolled. The motorway system has a length of more then 2000 km.

All vehicles below, or with 3.5 tons MLW are subject of a mandatory toll sticker. In addition to this system, six tunnels and special highway sections (approx. 100 km) vehicles below 3.5t maximum permissible weight are tolled at manual toll stations at each passage.

All vehicles above 3.5tons MLW are tolled by the Austrian distance related electronic tolling system for trucks and coaches.

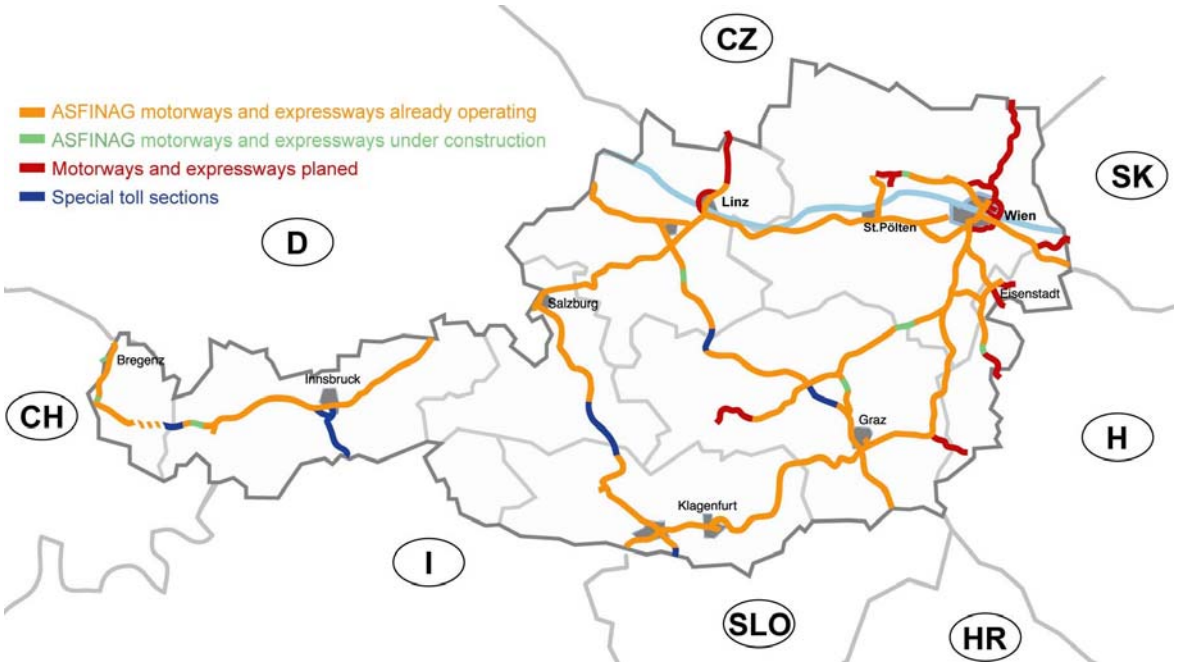


Figure 17: The Austrian toll road network

### E.1.2 Tarification and fee parameters

The fee is calculated through the following parameters: the tarif per kilometer, the km driven on the motorway system, the number of axles of the vehicle combination and in the future maybe the emission class of the vehicle.
The tarif per kilometer is higher on special toll sections.

### E.1.3 Legal basis

ASFINAG was founded in 1982. It is a stock corporation whose shares are wholly owned by the Federal Republic of Austria. In 1997 the company was given full responsibility for planning, construction, maintenance and levying of tolls on the Austrian network of motorways and expressways.
The rights of ASFINAG to collect toll is based on the “Federal Road Toll Law” (BStMG). The Federal Road Toll Law governs the rights and duties of ASFINAG on the one hand and of the road user on the other. This right of usufruct over all motorways and expressways in Austria was granted to Autobahnen- und Schnellstraßen-Finanzierungs- Aktiengesellschaft (ASFINAG) with the signing of the Usufruct Agreement concluded by virtue of the ASFINAG Authorisation Act 1997. Consequently, ASFINAG has the right to collect tolls from all drivers who use the federal highways or sections.

The road section toll will be collected by ASFINAG Maut Service GmbH, a subsidiary company of ASFINAG, on behalf of and for the account of ASFINAG. In accordance with the Tolling Regulations Part A II, the toll will be levied on vehicles with a maximum gross vehicle weight of up to 3.5t. The Federal Road Tolls Act 2002 and the provisions of Tolling Regulations Part B apply to vehicles with a maximum gross vehicle weight of more than 3.5t. These Tolling Regulations are formally approved by the Federal Ministry of Transport, Innovation and Technology in agreement with the Federal Ministry of Finance according to the Federal Road Toll Law.

As an example of the depth of legal documents: The Federal Road Toll Law states that all vehicles driving on an Austrian motorway have to be equipped with an OBU to pay the distance related toll, while the Tolling Regulations specifes the OBU they have to be equipped with.

### E.1.4 Organisational structure

The Autobahnen- und Schnellstraßen- Finanzierungs- Aktiengesellschaft, ASFINAG is the operator (Transport Service Provider) of the Austrian motorways.

The Electronic Fee Collection and the issuing of Service User contracts for EFC is provided by the ASFINAG Maut Service GmbH. The ASFINAG Maut Service GmbH will be in charge of all tolling operations in Austria, and has two roles: GO-Maut Service Provider (Contract Issuer) and Toll Charger.

The system started operation successfully on 1st January 2004 and was built and operated by EUROPPASS in behalf of ASFINAG. Since 1st January 2006 EUROPPASS is fully integrated in the ASFINAG Maut Service GmbH.

### E.1.5 Toll system description

Figure 18: An Austrian tolling gantry and the GO-Box (Austrian OBU)

The tolling system makes use of a mandatory on-board-unit (called GO-Box), which is based on DSRC compliant to CEN standards (5.8 GHz). It is buildt as an open toll system (i.e. the driven distance is determined by the motorway sections used), with free-flow multilane tolling technology, which collects toll without any obstruction of the traffic flow: on each motorway section, a free-flow multilane tolling station debits the fee due. In addition to these new tolling stations, beacons are installed also at the existing low-speed single-lane tolling stations (at six tunnels and special highway sections): in this way, the special fee can be charged through DSRC and does not have to be paid manually.

The GO-Box allows the declaration of the number of axles of the vehicle combination through a simple button.

250 Point of Sales (PoS) are installed at petrol or border stations: the DSRC personalisation stations have been installed in the petrol stations near the cash register. The personnel of the petrol stations has been educated to personalise and substitute OBEs and charge belated payment of fee to users that signalled irregularities. Further information is available at the call centre and the internet portal.

As payment means the major credit and petrol cards, as well as Maestro cards are available. For reloading of Pre-pay OBEs cash is also accepted. In Austria no rebate system exists.

### E.1.6 Enforcement

Approximately 100 toll stations are also enforcement stations. HGVs and coaches are detected and checked if a correct transaction has been performed. In addition, portable monitoring systems are used that can be set up as required along various toll routes. If no complete transaction has been performed, if the OBE is blacklisted (due to: non valid payment means, theft, lost) or in case of “false axle declaration”, a front and overview photo is taken and sent to the central system. The photos are manually checked on correctness. For domestic users the fine is sent home. For foreign users the violation remains 3 months in the database.

Enforcement officers at border stations or in special enforcement vehicles have on-line access to the database at anytime in order to check a foreign vehicles “criminal record”. If the toll is not paid properly, the person evading the toll has the opportunity to immediately pay substitute toll. In the event of total failure to pay the distance-based toll (truck, bus, motor home), the substitute toll is currently 220 euros; 110 euros for indication of the incorrect category / number of axles. If the corresponding fees are not paid, administrative penalties follow.
Roughly 130 employees of the service and monitoring service work day and night to ensure that rules of the Austrian toll system are obeyed by the Service Users. At the same time, they support motorists with advice, assistance – e.g. for breakdowns or accidents – and information in all toll issues.

### E.1.7 User interface to the EFC system

The multilane free-flow tolling stations do not have any “signalling devices” to communicate with the user. At the passage at a tolling station, with one beep the OBE (GO-Box) signalises: “transaction OK”. When no beep occurs at the passage at a tolling station (no transaction occurred), the user has not to stop at a PoS. The driver is no longer required to take any action when the GO-Box does not beep when passing trough a toll portal. The missing toll transaction will be added and charged automatically from the users debit for Post-Pay Service Users. For Pre-Pay Service Users, missing transactions will be cumulated and invoiced the next time a credit is loaded on the unit at a GO point of sale.

With four beeps, the OBE signalises that the transaction was not ok and that the user has to visit a PoS in order to avoid the fine. With two beeps the OBE warns the user that his OBE or credit is expiring.

The Austrian GO-Box has a means to check its status (OK, out of order, or low pre-pay credit) at any moment. It allows declaration of the number of axles of the vehicle combination through a simple button and four LEDs.

At the SelfCare portal at www.go-maut.at, Service Users can find detailed information and practical tools (e.g. tool calculator). In a secure area, they can also view their billed toll transactions.
Receipts of the last 30 transactions (date, time, station, fee paid, result) are stored in the GO-Box and can be printed out at any PoS. This feature (in the DSRC transaction) is not compliant with the A1 Standard.

### E.1.8 System figures

- Number of distributed OBEs (and active contracts – end of December 2005):
  - Foreign users: approx. 600.000
  - Domestic users: approx. 96.000
- Average transactions and driven kilometres on the network:
  - Approx. 2 million transactions per day
  - Approx. 9 million kilometres per day (1 transaction each motorway section - 4.5 kilometres)
  - Transactions of domestic vehicles in the year 2005: 312.050.602 million
  - Transactions of foreign vehicles in the year 2005: 236.961.681 million
- Number of foreign vehicles that drove on the network, in the year 2005 for some countries:
  - Italy: 40900

- Slovenia: 10500
- France: 8600
- Switzerland: 6700

## E.2 LKW Maut Germany

### E.2.1 Summary

In 1998 The German Government decided to implement a distance-based tolling system for heavy goods vehicles (HGV with a maximum permissible weight of 12 t) on federal motorways as a substitute for the time-related vignette-system. On 1st January 2005 a tolling system based on GPS/GSM technologies started operation. The system and its operator Toll Collect had been chosen by the Federal Ministry of Transport, Building and Urban Affairs (BMVBS) within the scope of a Europe-wide award procedure.
Using an On-Board Unit (OBU) automated calculation and charging of the driven sections of the motorway network is possible. In addition the system includes a second system access option. Manual booking is possible via Internet and via terminals at dedicated locations along the motorway network. When using this option the driver has to define the intended route and to pay in advance according to the classification and distance.
The toll rates are structured into two categories concerning the number of axles: up to 3 axles and 4 or more axles. For each of these categories a further differentiation according to three emission classes is made. The average charging rate is 0.124 Euro/km ( rates between 0.09 and 0.14 Euro/km).
Compliance with the toll regulations is monitored automatically at around 300 enforcement gantries as well as by stationary and mobile enforcement teams of the Bundesamt für Güterverkehr (BAG; Federal Office for Goods Transport).
In 2005 2.85 bn Euro toll revenue was generated. The revenue is earmarked to improve the transport infrastructure.

### E.2.2 General

**Country / system / operator**

| | |
|---|---|
| **Country** | Germany (motorway network) |
| **System** | Dual Charging System based on an autonomous GPS/GSM based automatic system and a manual charging on terminals and internet |
| **Operator** | Toll Collect, on behalf of the Federal Office for Goods Transport (BAG) |

Table 1: general overview

**Basic characteristics**

The German truck tolling system is applicable for the whole German motorway network with a total length of more than 12,000 km (except a few short links close to the French and Swiss borders).
All heavy goods vehicles (HGV) with a maximum permissible weight of at least 12 tons are liable for tolling.

**Legal basis**

The BAG, acting as authority subordinated to BMVBS, ensures the compliance with the German regulations on road haulage.
The German HGV toll is a fee under public law, which is not a matter of VAT. The toll is collected by a private operator and passed on one-to-one to the public budget. The operator is paid for the services

according to a contract. The toll revenue is used in its major part for construction and maintenance of the German road network.

**Organisational aspects**

BMVBS initiated a Europe-wide technology-open and functional procurement procedure for the planning, installation, and operation of the dual HGV tolling system. The contractor Toll Collect is responsible for implementation, financing and operation of the tolling system, the toll collection, the distribution and marketing, Service User relationship management as well as all necessary technical activities resulting from the automatic enforcement. BAG has the duty of statutory means of enforcement, of monitoring of the operator, the contractual management and all monitoring tasks related to public administrative issues. The revenue from the toll collection is passed on to the federal budget by BAG.

**Objectives of the system**

The essential objectives to be achieved by means of the German truck tolling system are:

- Strengthening of the user-pays-principle
- Incentive for a more economic use of transport capacities, avoidance of empty runs
- Enhancing the competitiveness of the railways and inland waterways
- Provision of additional funding for transport infrastructure
- Emission-related toll to support the protection of the environment
- Encouragement of innovative technologies by means of a technology-open and functional procurement procedure
- Incentive for the use of environmentally friendly HGVs

**Imposed restrictions/requirements**

The essential requirements imposed on the system design by the political level are summarised as follows:

- Non-discriminatory access to the network and the system for all users
- No system-inherent intervention in traffic flow
- Quantity structure for the enforcement equipment (e.g. enforcement gantries, enforcement vehicles)
- Securing the system's integrity by means of minimisation of user interaction, by transparency, by comprehensibility and fairness of tolling and enforcement
- Flexibility concerning enhancement of the tolling system including enlargement and reduction of the network, adaptation of categories and tariffs, inclusion of vehicles with a lower maximum permissible weight

### E.2.3 Functional and technical description

**Technical platforms and solutions, functional solutions**

The German tolling system offers the user three different ways to log-on (see Figure 1):

- Automatically using an On-Board Unit installed in the vehicle
- Manually via the Internet
- Manually at over 3,500 toll station terminals

The mainstay of the system is the automatic log-on procedure. An OBU installed in the vehicle uses satellite signals (GPS; Global Positioning System) and other positioning sensors to automatically determine whether a vehicle is travelling on a tolled road section. The OBU pinpoints the location of the vehicle and can identify its position on any of the 5,200 motorway sections of about 24,000 km (both directions added) of the German motorway network. Once the position of the vehicle is located, the unit calculates the road use charges and transmits this information at certain intervals via GSM (Global Standard for Mobile Communication) to the Toll Collect computing centre.

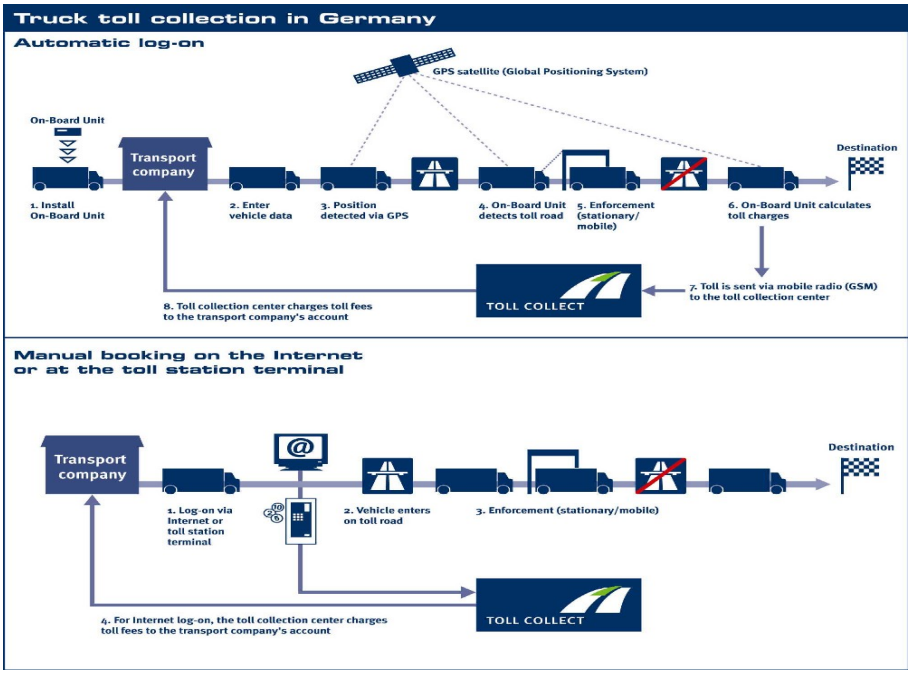


Figure 19: German HGV Tolling System

As an alternative, vehicles can be logged-on manually. The driver or Transport Company can book a trip on a toll road at a toll station terminal or on the Internet prior to using that road. This information is transmitted to the Toll Collect computing centre.

**Charging**

There is no obligation to book automatically.

In order to use the automatic tolling system each vehicle and its keeper must be registered with the operator. After the registration process the vehicle can be equipped with a personalised OBU (assignment to the license number) at one of the service partners (garages) authorised by the operating company Toll Collect. The installation of the OBU takes less than 4 hours. The costs for the installation correspond to the usual hourly rates of garages in the market. To raise consumer acceptance the OBU is given away at no charge today, but the operator keeps hold of the ownership. At the registration the user also has the choice to use a pre-payment or a post-payment account.

The technical solution is based on GPS navigation to autonomously determine the motorway section to be charged for. To do so a model of the tolled road network stored in the OBU is used as reference. The OBU is also equipped with a DSRC interface based on infrared technology to assist the charging functions – e.g. in case of non-availability of the satellite signal within tunnels – and to enable enforcement.

The toll is calculated for each toll section as determined by the OBU. The toll is charged according to the tariff parameters stored within the OBU. Afterwards the toll is temporarily and securely saved inside the OBU. At the same time the charged toll will be displayed and an electronic receipt for enforcement will be generated. The temporarily saved toll is transmitted periodically to the central system of Toll Collect via mobile communication (GSM). At this place the due tolls are accumulated to journeys and are balanced on accounts of the user. The mobile communication is also used to update the toll route network, the tariff and if necessary the software of the OBU.
The manual tolling system is mainly based on a network of toll terminals. These toll terminals are installed at so-called “toll stations” . The toll stations operate day and night and are located close to toll roads in petrol stations and motorway service areas and at the borders to the neighbouring countries of Germany. Furthermore the manual toll system provides an internet access. As for the automatic tolling system the user has to register himself with the operator to use the internet.

**Enforcement**
The enforcement is done as a sample based on four enforcement methods – automatic, stationary and mobile checks at the motorway, and checks in German transport companies.
The automatic enforcement takes place at 300 gantries located within the tolled road network. At these places toll violations are automatically detected and respective evidence (picture and data) are generated and transmitted to the centre of the operator. The operator has the task to double-check the automatically generated evidence files manually. For confirmed toll violations the registered keeper of the vehicle is determined and post-payment of the due toll is requested. At the same time the evidence case is sent to BAG to determine toll recovery and fine.
At 150 locations on the tolled road network the automatic enforcement can be used for stationary enforcement by the BAG. In this case the evidence file will be sent locally from the gantry to a controller at a rest area following the enforcement gantry. Violating vehicles are flagged down and a stationary check is executed. If no proof can be given for the actual distance the vehicle covered on the motorway, an amount according to the toll of 500 km must be paid. If a proof is given, the toll for the relevant distance is demanded.
The BAG also uses approx. 280 mobile enforcement vehicles to check for an electronic receipt in the OBU or a centrally stored receipt of a manual booking. If no valid receipt is available the officer of BAG has the right to flag down the possible toll violator from traffic for further inspection.

### E.2.4 Statistics for 2005

**Charging**

| | |
|---|---|
| Number of OBUs distributed | approx. 482,300 |
| Number of service points for OBU distribution (Europe) | approx. 1,900 in 19 countries |
| Number of manual booking terminal locations | approx. 3,500 |
| Number of tolling points on the motorway network | approx. 5,200 |
| Percentage of toll paid via automated system | 86.0 % |
| Percentage of toll paid via manual system | 13.0 % |
| Percentage of toll paid via internet booking | 1.0 % |

**Enforcement**

| | |
|---|---|
| Percentage of toll violations | below 2% |
| Number of cases of toll recovery and fines: | |
| • toll recovery | 34,000 |
| • fines | 35,600 |

## E.3 LSVA Switzerland

### E.3.1 Tolled infrastructure and vehicles subject to toll

In Switzerland all roads are tolled. The total network length is more than 70'000 km. The TSP of the roads are the Swiss Federal Roads Authority for the national (1'759km) roads, the 26 Swiss Cantons for the cantonal roads (18'088km) and the 2'740 municipalities for the municipal (51'446km) roads.

All vehicles for goods transport above 3.5tons MLW (maximum laden weight) are subject to the distance-related Swiss Heavy Vehicles Fee (LSVA), while vehicles for passenger transport above 3.5tons MLW are subject to the flat-rate Swiss Heavy Vehicles Fee (PSVA).


Figure 20: The Swiss main road network

### E.3.2 Tarification and fee parameters

The LSVA is dependent on the driven distance, the maximum permissable weight of the vehicle combination and the tarif which is emission dependent.

**Distance** X **Weight** X **Tariff**

### E.3.3 Legal basis

The LSVA is based on the Swiss Heavy Vehicles Fee (SVAG) and the Swiss Heavy Vehicles Regulation (SVAV). Concerning the definition of an interoperable service the most important articles are assorted.
The basic principles are defined in the law:

- vehicles which are subject of charge
- Tarification and fee parameters
- Liable person(s)
- The liable person is obliged to co-operate
- Gives the possibility to mandate the equipment of the vehicle with an OBE
- Gives the discretionary power to assess the fee in case of not suitable declarations
- For foreign vehicles the claimed charge is due for payment by leaving Switzerland

The content of the regulation is more oriented on the concrete implementation:

- The distance has to be measured with the tachograph
- Organisational structure for the levy of the fee
- Obligation to equip Swiss vehicles
- Charging procedures, i.e. the fee relevant data have to be declared by the liable person(s) {self-declaration}
- Obligations of the driver
- Assessment of data declared by liable person, possibility to demand further evidence by the liable person and in case of discrepancy the assessment according to one's best judgment.

Both realised implementations are derived from these principles. There is a duty to declare the ton-kilometre performance in Switzerland. Therefore the entries and exits as well as changes in the MLW have to be registered.

Foreign hauliers are only allowed to import to, export from or transit goods through Switzerland (cabotage law).

### E.3.4 Organisational structure

The Swiss Customs is the operator of the LSVA toll system on behalf of the Swiss Confederation. Service User contracts have not to be issued as the LSVA is a legal duty.

### E.3.5 Toll system technology

The LSVA is a dual system: an Electronic Fee Collection system and a manual system. Both systems are designed on the same principles. The LSVA is similar to a closed system as entries and exits are registered.

Electronic Fee Collection System

In the EFC system the vehicles are equipped with an OBU called Tripon. The OBU is mandatory for Swiss vehicles and optional for foreign users. The OBU cost of about 1000€ are covered by the Swiss Confederation, only the installation costs of about 200€ have to be covered by the transport operator.

The OBU records the kilometres driven on Swiss territory from the tachograph, supervised by a satellite positioning system (GPS, internal antenna) and a internal movement sensor. When a trailer is connected the MLW of the trailer and licence plate of the trailer has to be declared by the driver on the OBU. The OBU is a data collector and is logging different events on-board when in operation; e.g.:

- A CEN Standard DSRC link (5.8 GHz) is used for recording entries and exits to/from Switzerland. All border crossings allowed for HGV are equipped with DSRC beacons.

- With the help of GPS (unauthorised) entries to Switzerland on roads not equipped with DSRC are detected
- Declared attachments or detachments of trailers
- Detachment of the OBU from the windscreen
- Driving with power supply disconnected form the OBU
- Deviation of the tachograph kilometre recording compared with the GPS distance measuring over an accepted limit

Figure 21: A Swiss Border station equipped with DSRC beacon and the Swiss OBU

The DSRC is also used to switch the OBU on or off when passing the border and for reading out the recorded events stored on-board for equipped foreign vehicles. Swiss users declare their recorded on-board events regularly by sending in a chipcard or by internet.
Therefore the registering of the border crossings are very similar to a closed tolling system, the changes in MLW as well as the km registering and charging supervision are autonomous parts of the LSVA system.

Manual system

Foreign users have to register their vehicle upon first entry to Switzerland at the border. The static fee relevant parameters are verified by checking the vehicle documents and are stored on a LSVA ID-Card (chipcard). With every further entry they have to declare their entry mileage from the tachograph and current MLW as well as the payment mean (petrol cards, customs account or cash) to be used at self-service clearance terminals using their LSVA ID-card, receiving a physical entry ticket. When leaving Switzerland the entry ticket has to be handed over to the customs personnel, after the exit mileage and eventual changes to the MLW have been added by writing. For cashless payment the driver has not to leave the vehicle, for cash payment the driver has to consult a cashier.

The fee calculation is done for both systems in the central system by taking into account the charging events fully automatically. If there are special events recorded in the logged data or delivered by the enforcement system the vehicle data is analysed by an Swiss Customs Operator and the fee is calculated manually. The Swiss LSVA law allows a manual assessment of the vehicle for a certain period if there are reasons to believe that the declaration of the user is not correct.

### E.3.6 Enforcement

As described above the OBU is supervising the correct functioning of the OBU with several additional sensors. The logged events will be looked at on the one hand in the manual toll assessment (e.g. resulting in a higher toll than declared by the user) and on the other hand in the detection of toll violations (e.g. resulting in the issuing of fines).
About 18 enforcement gantries located on the motorway network check the passing HGV

- Equipped vehicles:
  - correct functioning of the OBU
  - correct declaration of fee relevant parameters (i.e. mainly the existence of a trailer declaration in case of attached trailer)
- Unequipped vehicles:
  - Existence of an entry declaration
  - Correct declaration of fee relevant parameters (i.e. mainly the existence of a trailer declaration at entry or exit in case of attached trailer)a trailer at entry or exit

The passages of an unequipped HGV will be recorded at these stations and together with the entry and exits of the same vehicle a check of the driven kilometres can be performed.

Additionally one mobile patrol unit is checking vehicles on other roads (without stopping the vehicles), manly perfoming the same functions as the automatic stations.

At the border stations the Customs staff are perfoming spot-checks of correct entry/exit declarations.

Detected violations with Swiss vehicles are enforced by the Cantonal authorities (mainly by postal notifications). The measures to be applied include also the obligation for the user to visit a certified garage to check the correct installation of the OBU.

Foreign toll violators will be stopped and enforced by the Swiss Custom either while exiting Switzerland or upon next arrival (i.e. the manual entry declaration is not possible without contacting the Swiss Customs.

The OBU can not be turned off, i.e. an installed OBU is always active. Even when dispatched from the power the OBU recognises movement of the vehicle.

### E.3.7 User interface to the EFC system

There are several man-machine interfaces available.

A small green LED indicates the correct functioning of the OBU to the driver when the ignition is turn on. This LED turns red when a malfunction is detected. A long beep supports this at the moment the LED turns red and every time the ignition of the vehicle is turned on again. For some malfunctions short descriptions are given on the display.

The small display is used to show the current mileage and the current settings concerning the trailer declaration. When passing a DSRC exit or entry beacon a short beep indicates a correct DSRC transaction and the generated event (border crossing) is shown on the display.

The OBU has also a small keyboard with 9 buttons (up, down, left, right, trailer, esc, OK, S, reserve). The keyboard is used to declare a trailer and gives also the possibility to scroll through the registered events on-board.
The registered events can also be looked at by a special software on private PC if equipped with chipcard reader.
The sensor data are also offered on a infrared interface for public use.

### E.3.8 System figures

- Number of installed OBU:
  - National users approx. 52.500
  - Foreign users: approx. 2.000
- Number of issued LSVA ID-chipcards:
  - Foreign users: approx. 560.000
- Average driven kilometres on the network:
  - Approx. 7,7 million kilometres per day