An example of a view
on
interoperability in tolling
and on
achieving the aims of Directive 2004/52

Jan Vis,

Delft, November 30th, 2006

In der Beschränkung zeigt sich erst der Meister

It is in self-limitation that a master first shows himself

Goethe(1749-1832)

Pluralitas non est ponenda sine necessitate

Plurality should not be posited without necessity

Ockham's razor

William of Ockham (ca. 1285-1349)

Foreword

In its meeting on the 28th of June 2005 in Leeds the Stockholm Group noticed a lack in common understanding and vision on interoperability in tolling and on the aims of EU Directive 2004/52. The Stockholm Group then decided to examine its interpretations of the Directive and to formulate a common vision on the subject. This example of a view provides the analyses on which the vision paper will be based. It reflects our current view on the subject and may be updated when needed. It is a technical paper in the sense that less concerned with policy, desirability or what should be accomplished but more with possibilities and what can be accomplished.

This paper does not aim to include all views of all members (the common multiple) but at a common denominator. Starting from the basic interoperability scheme, aspects are only added if necessary.

Even though the subject may be sometimes abstract, the view should be readable for the layman with a common knowledge of tolling. By providing supporting legal and IT technical data in footnotes the text aims to bridge both worlds while being readable for either experts.

The paper has been discussed at three workshops. Both Cesare III work package teams and CEN TC278 / WG1 were invited to comment. Valuable comments were received from Cesare III colleagues on earlier but related issues.

History

This paper is an update of the Stockholm Group version (Ljubljana, March1st, 2006). Copies of the original paper are still available via the Stockholm Group secretariat, ITS Sweden. Please, contact Maria Simmins at maria.simmins@its-sweden.com or +46 243-618 02.

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Terminology

The terms 'toll charger' and 'toll service provider' as used in this paper correspond as follows to terms used in Directive 2005/52, in the Cesare III project and by CEN TC278/WG1.

This paper	Directive 2004/52	Cesare III main actors	CEN TC278 / WG1
Toll charger	Operator	Toll charger	EFC operator
Toll service provider	Issuer	EETS provider	Contract Issuer

Contents

1. Introduction

1.1 The goal of this paper

This paper provides an example of a view, covering both interoperability[1] in tolling and ways to achieve the aims of EU Directive 2004/52.

The aim of the Directive is quite clear:

> *One 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 toll systems.*

It does so by focussing on what is called the 'basic interoperability scheme'. This scheme is extended with only those issues with impact on the interoperability as defined in the basic scheme.

It aims at a situation in which toll systems can evolve and in which new tariff schemes can be introduced as required by the subsidiarity principle.

1.2 Scope

The paper limits itself to the interoperability between OBE and toll[2] systems under the operation of EU Directive 2004/52.

Systems that do not rely on OBE and which are therefore out of the scope of this paper are e.g:

- The non-EFC systems with the classic toll booth (with cash payment or subscriptions)
- Booking systems like the London system or the booking system used in Germany.

As these kinds of systems do not require OBE and therefore require no co-operation between toll chargers and toll service providers, interoperability is not an issue for these systems.

1.3 View statement

The view expressed in this paper focuses on the essence of interoperability. This paper does not provide a lengthy survey of everything that may add to the subject, but tries to reduce the subject to what is really necessary.

By focussing on the essentials we will not only gain a better view on the subject but we may also be able to reduce the complexity of the arrangements and provisions needed to achieve interoperability.

The approach then is quite simple: start with the basic issue and only add what is really necessary.

More in detail:

- First, address what is called the 'basic interoperability scheme'
- Second, identify possible additional issues and label them either as having or not having impact on interoperability arrangements
- Third, if an issue has impact on the interoperability arrangements, elaborate that impact and require only what is necessary.

[1] Where interoperability is defined as the ability to operate in conjunction (see the SOED)

[2] In this paper, as in Directive 2004/52, the term toll also includes a tax or other kind of fee.

2. The basic scheme

2.1 EETS

The aim of the Directive is quite clear:

> *One 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 Europea toll systems*[3].

The reason behind is that it is in the interest of the user (cheaper and/or more convenient) to have only one contract and only one set of OBE than a separate contract and/or a separate set of OBE of each single toll system or group of national toll systems.

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.

An EETS is defined as a service which shall be provided irrespective of the place of registration of the vehicle, the location of the toll domain, the nationality or residence of the service provider or service user[4]. OBE used for an EETS shall be interoperable with all toll systems within the EU[5].

It is assumed that the providers of an EETS will operate in competition with each other[6].

For toll regimes, both the subsidiarity principle and the non-discrimination principle apply. Every Member State is free to define its own toll regime[7] (the subsidiarity principle) as long as it does not discriminate vehicles from other Member States (the non-discrimination principle).

Note that the Directive requires merely requires the availability of an European electronic toll service that fulfils the EETS requirements. This does not exclude the use of other – for example regional – electronic toll services.

Also note that the term 'toll' in the Directive includes all types of fee like charges, taxes etc.[8].

2.2 The basic interoperability scheme

The basic interoperability requirement is that OBE shall be made available that can be used for all toll systems[9] throughout the EU[10]. This requires the OBE to be interoperable with these toll systems[11].

This basic interoperability scheme in depicted in figure 2-1below.

The left side of the figure represents the toll payment, the right side the toll collection. The boxes on top represent the actors, the bottom boxes the equipment they control.

The OBE is supposed to operate under the responsibility of a toll service provider, the toll system under the responsibility of a toll charger[12].

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[3] I.e. all toll systems under the operation of the Directive as stated in 1.2 Scope

[4] 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."

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

[6] However, in practice it may be difficult to create the EETS anyway.

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

[8] See article 1(1) 'all types of road fees' and article 3(2) 'independent of … the purpose for which the fee is levied'.

[9] A toll system only comprises the off-board equipment; not the OBE (which would otherwise be part of all toll systems).

[10] More precise, all toll systems under the operation of EU Directive 2004/52.

[11] Note that this OBE do not necessarily have to support all current operational interfaces between OBE and toll systems. Harmonisation of the interface(s) with toll systems might be feasible as well (as with e.g. the CardMe transaction).

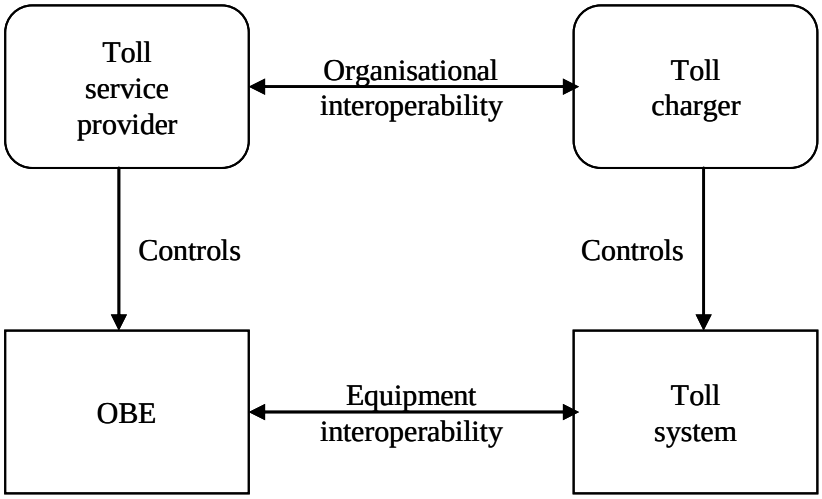

Figure 2-1 The basis interoperability scheme

The basic idea is that a valid ´toll declaration' from OBE to a toll system provides a toll charger with a valid claim for the fee on a toll service provider and/or its customer[13].

The toll service provider is the provider of toll services for one or more toll domains. More specific in the context of this paper, an EETS provider is a toll service provider providing the EETS[14] for all toll domains under the operation of Directive 2004/52.

Basically there are three types of relations between a toll service provider and a toll charger[15]:

1. The toll service provider act as reseller of toll
   The toll service provider buys the toll, i.e. the permission to use a vehicle in a toll domain, from the toll charger and sells this permissions to his customers[16].
2. The toll service provider acts as an agent of the toll chargers
   The agent paradigm is used for CESARE II and is most suitable in case toll is regarded as an (administrative) obligation (e.g. a tax or duty) that has to be paid and not as something that can be (re)sold. Most often, the agent is also required to provide a payment guarantee for the toll to be paid by his customers.
3. The toll service provider acts as a factor who takes over and collects debts owed to toll chargers.

Arrangements concerning the organisational interoperability between the toll service provider and the toll charger should at least encompasses an agreement on:

1. dissemination of toll regime information (e.g. tariffs) to (the customers of) the toll service provider,
2. toll fee billing and payment[17] procedures
   (including the equipment interoperability of their administrative systems),
3. the equipment interoperability between the OBE and the toll system, and
4. exception handling (breaches of agreements, black lists, etc.)
   (including the equipment interoperability for e.g. the exchange of black lists)

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[12] At this point the term toll charger may be read as an amalgam of the one responsible for the toll system, its principal and/or its subcontractors. See also the foreword and section 3.1 for more details.

[13] Depending on the contractual framework..

[14] This is consistent with the 'issuer and/or operator' in the Directive as the same company may act both as a toll service provider and a toll charger.

[15] The CESARE III project supported both reselling and the (direct and indirect) agency.

[16] Reselling may not be possible if the toll is a tax or fee for a public service.

[17] From a business perspective payment is the ultimate goal and therefore the basic issue. However, billing and payment arrangements can be setup and changed much more easily or frequently then the communication between OBE and toll systems. Therefore this paper considers the equipment interoperability to be the main issue / problem.

The agreement on the equipment interoperability between the OBE and the toll system must at least encompass:

1. a complete definition of the information exchange protocols[18], covering the syntax, semantics and pragmatics of all information to be exchanged;
2. a complete description of the use of the underlying communication provisions[19];
3. a complete specification of the communication security provisions[20].

The information to be exchanged between OBE and a toll system must at least encompass:

1. account information (to whom can the invoice be sent)
2. tariff determination information (e.g. vehicle characteristics)
3. toll domain usage information (possibly including the applied tariff)

As will be shown is 3.5.1, the interoperability arrangements only support post payment from central accounts. Therefore, the OBE only supports charging and does not include any payment means[21].

2.3 The economics of the basic interoperability scheme

The cost of an EETS needs to be borne by its stakeholders. Without going into a quantitative analysis, this section provides a qualitative overview of the (division of the) cost for an EETS.

2.3.1 The cost of an EETS OBE

OBE that can be used with all toll systems[22] will be more expensive than OBE to be used with a specific toll system but probably less expensive than the cost of using different OBE for each different toll system.

Technologies that are currently in use are:

1. Microwave DRSC systems (in the near future only CEN DSRC and the Autostrada DSRC)
2. Infrared DSRC systems (in Germany and in the Netherlands)
3. Systems using cellular networks (GSM, GPRS)
4. Systems using a Global Navigation Satellite System (GNSS) like GPS, EGNOS or Galileo
5. A system using the tachograph (and in the future maybe other onboard equipment / sensors)

It should be noted that all five technologies are already implemented in the German system[23,24]. The basic construction costs of an EETS OBE meeting the current demands[25] might therefore not be much more than for the German OBE[26,27]. The extra costs for EETS OBE stem then from the design, development, testing and/or certifying of a more universal / complex OBE, probably mainly software costs that can be amortised by all units. And, new toll regimes also may require adaptations, new testing and/or new certifying, and updating or replacement of installed OBE.

Directive 2004/52 made already a good start in reducing the cost for EETS OBE by limiting the communication technologies for new toll systems. Requiring standardised communication protocols that also support the subsidiarity principle may even further reduce these costs.

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[18] In technical OSI terms, these are called application layer protocols. See ISO 14906 for the EFC application layer protocol to be used over a DSRC link and draft ISO 17575 for the application layer protocol to be used over cellular networks.

[19] This includes both an identification of all lower layer protocols and a specification of their use (the service specification).

[20] In technical OSI terms, security services provided by the application and/or lower layer protocols, see ISO 7498-2.

[21] As also pointed out in an email from Ken Perrett to João Pecequeiro on July 23, 2005.

[22] I.e. EETS OBE if it is also suitable for use in all types of vehicles, see article 2(2) of the Directive.

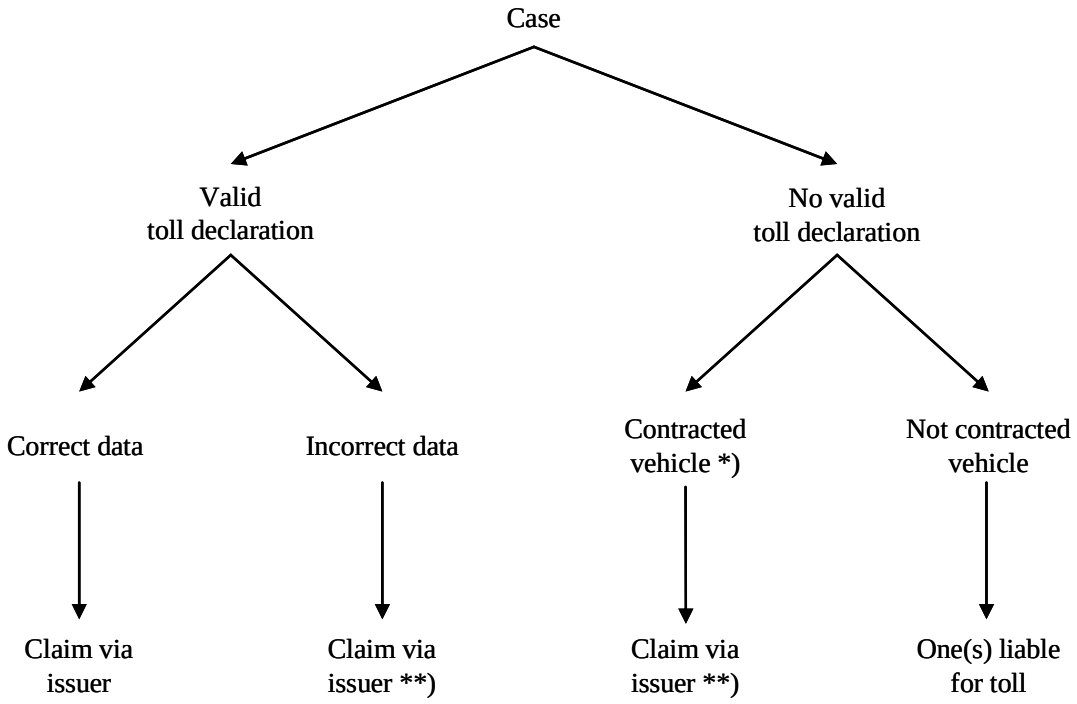
[23] Although the DSRC interface is only a bare interface for which, as yet, the application layer is not implemented.

[24] The Directive requires the use of one or more of 1, 3, and 4.

[25] Extra demands for e.g. extra storage capacity (e.g. for more comprehensive maps) and for extra sensors may however increase these costs.

[26] For the current toll regimes. See also section 3.5.5 for the (mitigation of the) subsidiarity principle.

[27] Also, the idea that an EETS OBE needs to support all current OBE-'toll system' interfaces of all toll systems is not supported by the Directive. E.g., a Cardme like solution by adapting toll systems to support common transactions may be agreed for GNSS based systems too.



*) tracing via a database with the issuer for each contracted vehicle, if established
**) depending on the contractual relationship between the issuer and the toll operator

Figure 2-2 Enforcement: main cases

2.3.2 Regional and vehicle type specific OBE

The Directive requires the availability of OBE that can be used for all types of vehicles and for all toll systems.

However not all vehicles are roaming through all of Europe and the OBE for heavy good vehicles (HGVs) may differ from the OBE for private cars. A toll service provider may therefore want to issue cheaper OBE that can only be used for specific types of vehicles (e.g. private cars) and in specific toll domains (e.g. the ones using DSRC) while providing otherwise the same service as an EETS.

Note that currently all toll systems use DSRC for private cars. So an EETS-like service for private cars might be a good start for a more complete EETS service.

2.4 Equipment interoperability, security and enforcement

Both toll service providers and toll chargers should trust the communication[28] between their OBE and their toll system. The toll system must be capable to distinguish valid toll declarations from OBE from invalid declarations. This is a technical issue that can be resolved by using communication protocols with adequate procedural requirements and security provisions[29].

[28] Including both charging and enforcement communication.

[29] In technical terms this is called non-repudiation, the property that neither the toll service provider nor the toll charger can deny in all or in part the participation of their OBE respectively toll system in a communication (see ISO 9498-2).

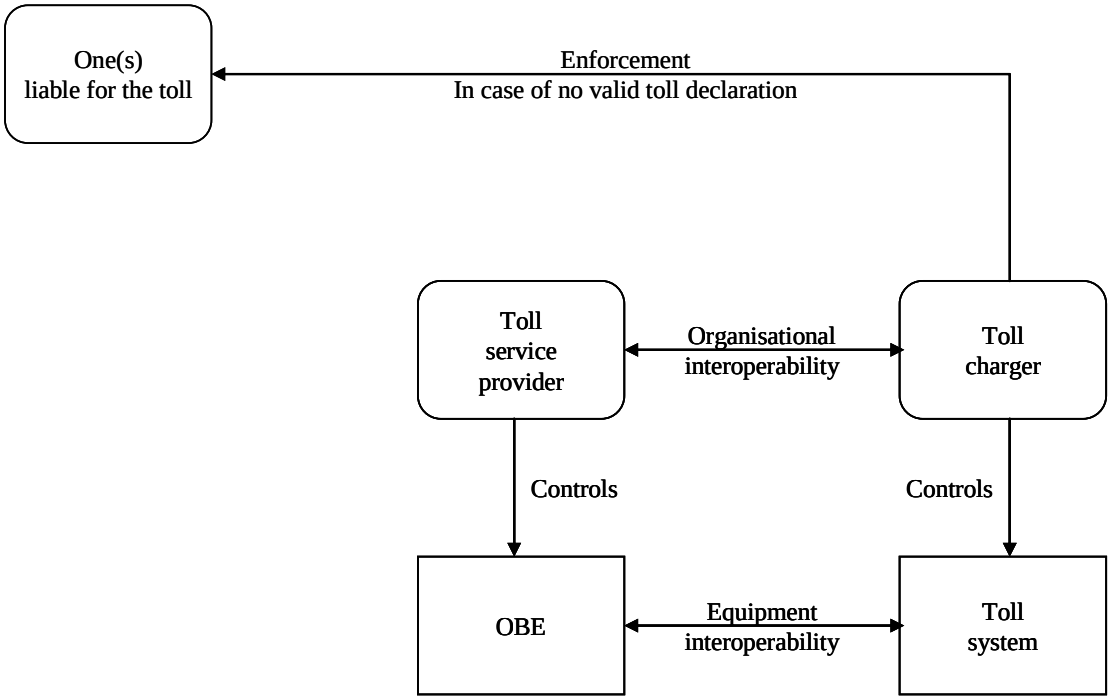


Figure 2-3 Basic interoperability and enforcement

Based on this requirement the following main cases can be distinguished (see figure 2-2):

1. the toll system receives a legally valid toll declaration from the OBE, i.e. the transaction data provide the toll charger with a valid claim for fee on the toll service provider and/or its customer[30]. In this case there are two sub cases:
    a. the data provided by the OBE show to be correct[31].
    This is the regular case in which the toll charger can charge the toll service provider as agreed.
    b. the content of the data provided by the OBE shows to be incorrect[32].
    This sub case is dealt with in section 3.3.2
2. The toll system did not receive a legally valid toll declaration from the OBE, e.g. because there is no OBE, the OBE is illegal, defect or sabotaged, or the toll system itself is malfunctioning. In case the toll charger wants to recover the fee (plus a possible penalty), he may (see Figure 2-2 and section 3.3.1):
    a. conclude an agreement with toll service providers, that the toll service provider will collect the money and stand surety for vehicles registered in the name of his customers[33] and/or
    b. hold the one(s) liable for toll responsible

    The one(s) liable for toll may hold in turn several other parties responsible for the defect, e.g.:
    a. the toll service provider,
    b. the OBE manufacturer (product liability),
    c. the OBE installer or maintenance organisation,
    d. the customer, the driver, the vehicle owner, etc.

[30] Depending on the contractual framework.

[31] Or, more precisely, not shown to be incorrect.

[32] This may be the case when e.g. the drivers did not declare a trailer. However, because the communication is authentic, the sender is known and can be held responsible for the incorrect content.

[33] This requires a database to retrieve the identity of the toll service provider whenever the registration number of a vehicle under a contract is known.

This, however, is a local issue. It shall not have any impact on the interoperability arrangements.

2.5 The current situation for the basic interoperability scheme

In this section the current situation with respect to the basic interoperability scheme is assessed on:

1. The communication between OBE and a toll system using DSRC links
2. The communication between OBE and a toll system using GSM
3. Valid communication providing a valid claim for the operator
4. Toll account support (toll account records)
5. The (lack of) suitable OBE and toll service providers providing an EETS.

Enforcement and other additional issues are further elaborated in chapter 3.

2.5.1 The basic scheme and communication using DSRC

The communication using DSRC has been completely standardised for all current toll regimes. For private vehicles these DRSC protocols can be used to provide an EETS-like service[34].

Much progress has also been made in the Media projects (for HGVs) and the PISTA project.

Nevertheless, some issues need to be addressed:

1. The support of both CEN DSRC and the DSRC used by Autostrada[35]
2. The extensibility of ISO 15628 is problematic
   (ISO 14906 uses a copy for its own purposes. But, if other standards do the same we may end up in a mesh)
3. It is unclear whether or not the current security provisions are sufficient for OBE suitable for an EETS
4. It is unclear to what extent the CardMe IV transaction is extensible (can be adopted to new vehicle parameters).

2.5.2 The basic scheme and communication using GSM

The communication between OBE and central equipment over cellular networks is to be standardised in ISO 17575. However, considering the amount of serious comments on the draft in March 2005 an acceptable new version is not to be expected before 2007. The draft has to be completely revised and divided into smaller parts or standards.

2.5.3 A Toll declaration providing a valid claim

The basic idea is that a valid toll declaration from OBE to a toll system provides a toll charger with a valid claim for the fee on a toll service provider and/or its customer has not yet been explicitly elaborated.

The moment a toll system regards a toll declaration from the OBE as valid, can be looked upon as the moment that a toll agreement is concluded or the moment that the one(s) liable for toll have fulfilled their toll declaration responsibilities.

The concept of a valid toll declaration from the OBE may be used as the 'linking pin' between:

1. the equipment operability and the organisational interoperability,
2. the toll service provider and the toll charger, and
3. the charging and enforcement measures and procedures.

[34] Also, the CardMe IV transaction is incorporated in ISO 14906, the EFC DSRC application layer standard.

[35] This issue seems to be (almost) resolved, see the [EG8] and [EG11] reports.

2.5.4 Toll account support

In order to facilitate the exchange of account information between toll chargers and toll service providers and, eventually, between toll service providers and their customers, the protocol for the exchange of this information should be standardized.

The basic unit of information to be exchanged might be called a 'toll account record' that

1. describes the claim for fee resulting from valid toll declarations as mentioned above and/or
2. may be used as an 'atomic item' on an itemized account.

2.5.5 The (lack of) OBE and toll service providers

Currently there is no suitable EETS OBE available. We are even lacking the specifications for such an OBE (there is e.g. no standard for the communication between OBE and a central systems using GSM).

There is at this moment also no organisation that clearly wants to become an EETS provider. This may be an indication that as yet no company regard it as a viable business case. A reason might be that some prerequisites are not yet in place. One might then think e.g. of communication requirements and some of the provisions addressed in the next chapter.

2.6 Recommendations regarding the basic scheme

Support, at least for the current toll regimes, the results of the Media and Pista projects and use these result to create an EETS like service for private vehicles in Europe.

In addition:

1. Examine and revise, if needed, the security requirements and provisions for the equipment interoperability.
2. Further elaborate the concept of a valid toll declaration.
3. Examine and revise, if needed, the extensibility of the DRSC protocols[36]
4. Standardise the communication protocols when using GSM.
5. Standardize the exchange of information between toll chargers and toll service providers, both for invoicing and charging related information[37].

[36] Including the extensibility of ISO 15628.

[37] Including e.g. the exchange of black lists.

3. Additional issues

In this chapter additional issues are identified and their impact, if any, on interoperability is described. These issues are grouped as follows:

1. additional toll charger / toll system related issues
2. additional toll service provider / EETS related issues
3. additional enforcement issues
4. additional OBE related issues
5. additional common arrangements

3.1 Additional toll charger / toll system related issues

3.1.1 Subcontracting

A toll charger may put out all kinds of jobs to subcontractors. One might think e.g. of:

1. the operations of the road side toll equipment
2. selling his accounts payable to a third party
3. outsourcing the management of the receivable accounts ledger
4. data and/or financial clearing (see section 3.5.3 below)
5. enforcement (see section 3.3 below)

As long as the toll charger remains responsible and all subcontractors are acting on behalf of the toll charger, subcontracting as such is not really relevant for interoperability arrangements. However, in case a subcontractor of a toll charger needs access to the OBE some arrangements should be made, see section 3.5.1.

3.1.2 Toll chargers acting on behalf of and in the name of their principal

In some cases a toll charger may act in the name and behalf of its principal being either a public or private entity.

In case invoices have to be paid directly to the principal the check on payments requires some co-operation between the toll charger and his principal[38,39]. This however is an issue that should have no impact on interoperability arrangements.

In case the principal has assigned a third party for enforcement and that third part needs access to the OBO, this may be technically resolved in the same way as a toll charger can arrange access to the OBE for other third parties[40].

In case the principal is a public institution some VAT issues may need to be resolved as well.

3.1.3 Agreements between toll chargers

From a strict interoperability point of view an agreement between toll chargers is not an interoperability agreement because it does not involve the toll service providers.

However, in practice such agreements may play an important role in harmonising both the organisational and equipment interoperability. This holds all the more as long as there is no regular harmonisation platform between toll chargers and toll service providers.

Integrated networks[41,42] also require arrangements between toll chargers. But in the context of this paper this should have no impact on the interoperability arrangements between toll chargers and toll service providers.

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[38] These payments ought to be based on an invoice or declaration and to come via the toll service provider, see 3.5.1 on Payment.

[39] Another possibility is that the fee is paid on an account for which the toll charger is the trustee. (Like in Germany)

[40] In order to reduce the complexity of the equipment interoperability, it pays if all third party access on behalf of the principal of a toll charger can be implemented as third party access on behalf of the toll charger.

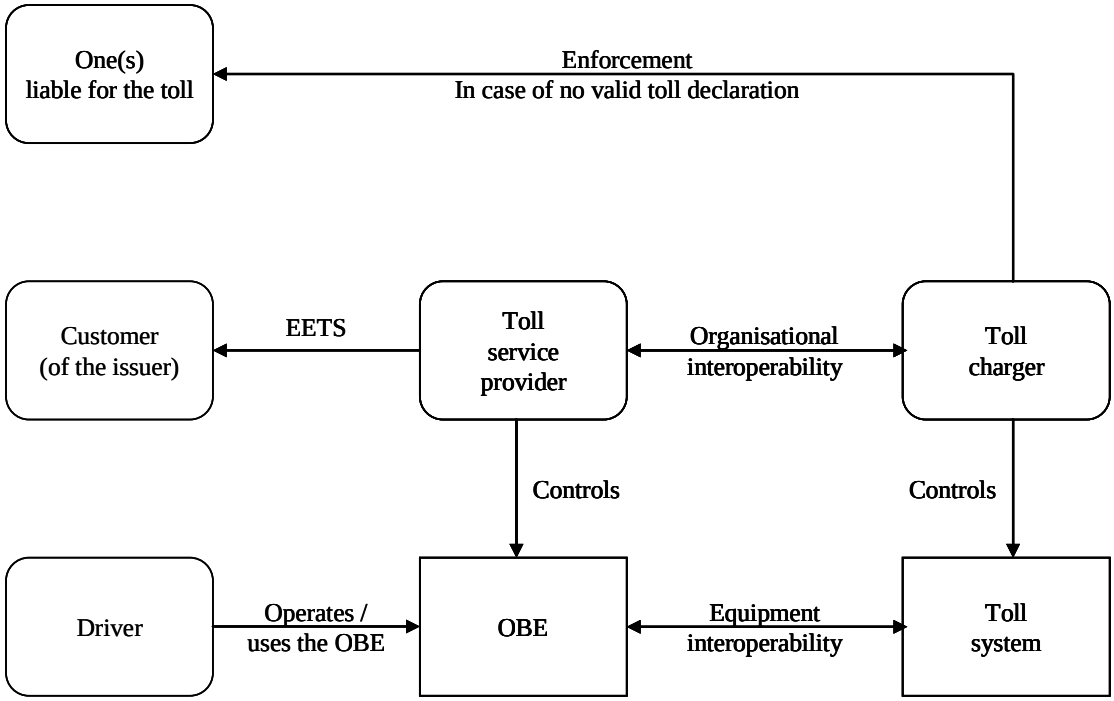

Figure 3-1 Basic interoperability and toll payment related actors

Another typical non-interoperability issue that might need attention is the communication between roadside equipment and central equipment. Standardisation of that interface will allow toll chargers to procure roadside equipment independent of the operation of their central equipment. This may be especially relevant when the roadside equipment is outsourced.

3.2 Additional toll service provider / EETS related issues

3.2.1 Additional toll service provider / EETS related roles

On the payment side several actors (roles) should be distinguished in addition to the toll service provider (see figure 3-1):

- the customer (of the toll service provider)
- the one(s) liable for paying the toll (who may differ from toll regime to toll regime)[43]
- The driver (of the vehicle)

In some situations one person is acting in all those three roles[44], in other situations those roles may be performed by two or more natural or artificial persons.

The customer is the one who has a contract with the toll service provider for an EETS for one or more vehicles. The customer is therefore the holder of the OBE. He might be the owner or lessee of the vehicle, a fleet operator, or any other third person.

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[41] An integrated network consists of two or more adjacent toll domains with two or more toll chargers, that behaves as one single toll domain to the OBE. When a vehicle leaves such a network it is charged for its whole trip through that network.

[42] However, if an integrated network should span different Member States we may also have to take VAT issues into account.

[43] One(s) (jointly and severally) liable for paying the toll may e.g. the driver, the owner, the possessor, the lessee, the registered keeper, the holder of the registration certificate, the one who disposes over the use of the vehicle.

[44] E.g. the registered keeper of the vehicle who is also its regular driver.

From an interoperability perspective the relation between a toll service provider and its customer should have no impact on the interoperability arrangements between a toll charger and the toll service provider[45,46]. Toll service providers may compete with other toll service providers for the customer. E.g. by providing a more attractive contract.

The one(s) liable for paying the toll are those who shall pay the toll under the operation of a particular toll regime. Who they are may differ from toll regime to toll regime. This, however, is a matter of the local toll regime that is relevant for enforcement[47] but should have no impact on interoperability arrangements as such.

The driver is assumed to be responsible for the operation (use) of the OBE (e.g. for setting the number of axles). However, the one(s) liable for the toll will be liable for such settings or, depending on the interoperability arrangements, the toll service provider may stand surety. And, if the driver is an employee, his boss may be liable as well. See also 3.3.2 Enforcement of incorrect OBE settings.

3.2.2 Subcontracting

A toll service provider may use subcontractors too. One might think of e.g.:

1. retailers
2. installation and maintenance of the OBE (see 3.4.3 below)
3. data and/or financial clearing (see section 3.5.3 below)

As long as the toll service provider remains responsible and subcontractors are acting on behalf of toll service provider, subcontracting as such is not relevant for the interoperability arrangements.

3.2.3 The business case for the toll service provider

An EETS requires an EETS provider, i.e. a toll service provider, and, consequently, a valid business case for that toll service provider. In other words, someone has to pay for an EETS[48].

The analyses below uses the term 'nominal fee' for the non-discriminatory fee levied under the toll regime of a toll charger. This nominal fee may include legal discounts for regular and/or large users and may also reflect legal differences in the handling cost[49].

From an overall / user perspective the division of the costs for an EETS might be guided e.g. by the following fair competition principles:

1. Fair OBE prices, a toll charger who 'subsidises' the purchase and/or installation of OBE for his own toll system should equally 'subsidise' EETS OBE.[50]
2. The cost of EETS OBE[51] should not be borne by users not using EETS OBE.
3. A toll charger should charge an EETS user[52] the same nominal fee as any other user.

In addition, toll chargers might also bear some of an EETS costs as they also experience advantages:

1. a single bill and a single payment for a large numbers of vehicles,
2. a payment guarantee,
3. no costs for issuing and servicing for a dedicated OBE for vehicles using EETS OBE, and
4. no or less costs for other user support.

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[45] Apart from requirements imposed by the toll charger for the (installation of) OBE operating under the control of the toll service provider in the vehicle(s) for which the customer requires the EETS service from the toll service provider.

[46] This is also consistent with the CardMe transactions in which the toll charger is only supplied with a so-called PAN (Personal Account Number) that identifies the account for the vehicle with the toll service provider.

[47] See section 3.3

[48] Note that the goal of interoperability arrangements is provide a user with a cheaper and/or more convenient solution than to let him make separately use of each single toll system.

[49] One e.g. may think of a different fee of equipped and non-equipped uses (as e.g. in Toronto).

[50] Legal arguments may be abuse of power or unfair competition.

[51] E.g. the development, manufacturing, distribution and installation costs.

[52] The toll service provider in case of reselling or his customer in case the toll service provider acts as an agent.

Note that the non-discrimination principle does not preclude a toll charger to compensate a toll service provider for his services.

Advantageous for a user of an EETS are:

1. a single bill and a single payment for all toll systems 'used' by his vehicle(s)
2. VAT recovery services may be provided by the toll service provider, if applicable.
3. no costs for acquiring and servicing of an additional OBE for each toll system.

A toll service provider may charge its customers some service fee in addition to the nominal toll fee.

In summary, a toll service provider may recover its costs for providing an EETS service by e.g.

1. Selling or hiring out EETS OBE
2. Service fees from the toll chargers (e.g. for collecting toll fees and standing surety)
3. Service fees from its customers (e.g. single invoices, single payments, VAT recovery).

3.3 Additional enforcement issues

3.3.1 Enforcement if the communication with the OBE is not valid

As noticed above a toll system may judge the communication with OBE not valid for several reasons: there may no OBE be installed, the OBE may be defective, the toll system may be defective, the communication may be jammed etc.

The enforcement process encompasses the following steps:

1. observe a toll offence, e.g. the fact that there is no valid toll declaration received from the OBE. And, if this cannot be settled on the spot[53], proceed with step two.
2. track down the one(s) liable
   Depending on the contractual arrangements between the toll service providers and the toll chargers, the toll service provider may collect the payment in case the vehicle is one of his customers.
   Also, depending on local legislation, the toll charger may be able to track down the one(s) liable for a local vehicle via the local vehicle registration authorities. In case of a vehicle from another state this requires cross border support as has been addressed by the VERA 2 project[54], see the VERA 2 proposals for eNFORCE and for a directive[55].
3. prosecute the one(s) liable (and/or propose a settlement)
   In case no toll service provider is standing surety, the toll charger may use legal procedures. See also the VERA 2 proposals for eNFORCE and for a directive for the cross border case.
4. make a final decision
   requiring a financial penalty to be paid by a natural or legal person.
5. execute the decision
   If needed with cross-border support under the operation of the EU Council framework decision 2005/214 of 24 February 2005 on the application of the principle of mutual recognition to financial penalties and further supported by the VERA 2 eNFORCE proposal.

Enforcement for local vehicles is considered a local issue. The vehicle, toll domain and toll offence are then all from or located in the same Member State.

[53] E.g. by using barriers and refusing access till all fee has been paid properly.

[54] The treaty 'to intensify the cross-border co-operation in particular to combat terrorism, international crime, and illegal migration' between six Member States may be less suited for the prosecution of traffic offences then the VERA 2 proposals. The first one seems to be geared to assistance in individual cases (e.g. in case of serious crimes) the latter proposals are much more suited for large numbers of simple offences. This, however, should be further examined.

[55] For further study: The usability of the VERA 2 proposals in case the toll charger is (acting in the name of) a private entity, e.g. a private transport service provider.

In case the VERA 2 proposals are accepted, a member state may bring toll offences, if needed, under the operation on the VERA directive. However, the possibility to do this for civil toll offences may depend on local legislation and needs further study. One issue is the access of private toll chargers to the registers kept by the vehicle registration authorities.

Conclusion and recommendation: Implementation of the VERA 2 or similar proposals is an important step towards a free flow EETS and should therefore be supported. However, the applicability of VERA 2 to civil toll offences still needs to be examined.

3.3.2 Enforcement of incorrect OBE settings

A valid toll declaration may still be incorrect. It may contain e.g. a wrong number of axels.

In case a toll charger notices a valid but incorrect toll declaration, the one(s) liable for paying the toll are liable for these incorrect settings as well.

A toll charger may then have a choice of three courses of action for recovering the correct fee (and a possible penalty):

1. he may apply step 2-5 of the enforcement procedure as described above
2. he may ask the toll service provider to reveal the identities of those liable for paying the toll and proceed with step 3-5 of the enforcement procedure as described above
3. he may ask the toll service provider to collect the correct fee and possible fine and to stand surety[56].

The second and third course of action also requires organisational interoperability arrangements between the toll service provider and the toll charger (those arrangements should also adhere to the privacy regulations in the countries involved).

3.4 Additional OBE related issues

3.4.1 Introduction

The additional OBE related issues below are considered to have no impact on the interoperability arrangement and should be resolved by the toll service provider(s) unless proven otherwise. Nevertheless as some may contribute to an EETS, these issues should be addressed as well.

3.4.2 An open market for OBE?

In case toll service providers want to use OBE from different manufactures it may also pay if not only the communication between OBE and a toll system is standardized, but also the communication between the OBE and off board equipment operated by the toll service provider. Such an interface may then be used for configuring or updating the OBE (see below) and/or to obtain logged data (e.g. a transaction log).

Other OBE features / interfaces that may be standardised are:

1. The visual/tactile/audile interface between a driver and its OBE
2. The installation of the OBE in a vehicle
3. The integration of the onboard tolling equipment with other onboard equipment
4. An application program interface for third party software (see section 3.5.1)

Note that in the classic situation, the onboard and off board equipment were often supplied by the same manufacturer. For an EETS this cannot be the case.

Potential advantages of standard OBE are:

1. cost reduction
2. pre-installation when the vehicle is manufactured[57]

[56] Even if e.g. the vehicle has been sold, the toll service provider may still be held liable for toll charges incurred by OBE for which he is responsible. The toll service provider may then in turn hold his customer, the holder of the OBE, liable.

[57] The toll service provider then only issues is SIM card to control the OBE, see 3.4.4 SIM card controlled OBE?

3. useful for all toll service providers
4. do not have to be replaced if the customer changes to another toll service provider.[58]

Conclusion and recommendations: The market should be encouraged to supply OBE suitable for an EETS or EETS-like service that fits standard into a vehicle and provides standard facilities for its communication with a toll service provider.

3.4.3 Service and maintenance for OBE

OBE must be serviced and maintained throughout Europe. Although this should not have any impact on the interoperability arrangements this should be well organised before a toll service provider becomes operational.

Measures that may help are:

1. harmonisation of service and maintenance instructions and procedures
   (in which case a local subcontractor can more easily serve more then one toll service providers and which may also reduce the service and maintenance costs.)
2. remote OBE update provisions for toll service providers (see also 3.5.1)
   (to allow a toll service provider to update his OBE in other countries in a secure way, e.g. at the premises of a service organisation).

Conclusion and recommendation: Harmonisation of the OBE service and maintenance instructions and procedures should be encouraged as well.

3.4.4 SIM card controlled OBE?

For cellular phones the phone can be obtained separately from the SIM card. For an EETS OBE a similar situation should be considered.

A major advantage of using such a generic OBE is that the OBE can be built into the vehicle irrespective of the toll service provider. E.g. then it can be built in by the manufacturer and left in the vehicle when one changes from one toll service provider to another.

It should be noted that in the future this may be the only viable solution. On board toll equipment may become more integrated with other equipment: it may share e.g. a Galileo receiver with onboard route guidance equipment, a cellular phone with emergency and after theft recovery equipment, it may use a digital tachograph (HGV's), a sensor for trailer detection, and it may read vehicle parameters from a vehicle registration certificate on a smart card, or an electronic registration tag as defined in draft ISO 24534. In such a context a toll service provider can not be made responsible for the operation of all toll related onboard equipment. Solutions in which the onboard toll related equipment is securely controlled and/or monitored by means of a SIM card issued by the toll service provider may then be more appropriate.

Such a situation will have an impact on type approval or OBE certification too. The main focus for type approval will then be on a reliable and valid communication. For the onboard charging processes the attention may shift from how the OBE is operating and secured to measurable results that can be securely monitored and recorded (e.g. with a trusted SIM card). Enforcement measures may then focus on the monitoring process and valid records.

Conclusion and recommendation: The concept of OBE for which the results are securely monitoring and recorded should be further examined and, if proven useful, be supported.

3.4.5 Quality / compliance assurance

The assurance of the quality has not yet been thoroughly analysed. Nevertheless two observations can be made:

[58] Only the SIM card has then to be replaced, see 3.4.4 SIM card controlled OBE?

1. Considering the increased complexity and integration of onboard toll equipment with other onboard equipment (see above) the focus should be on trusted behaviour of the OBE, instead of on the design of the OBE[59].
2. Considering the amount of toll chargers and toll service providers conformance testing should be performed by an independent body (certification).

The role of certification should be kept within reason. In case the communication with OBE is not valid, the toll charger should always be able to apply the necessary enforcement measures. And, if this should be the case because of the poor quality of the OBE, a toll service provider will soon lose its customers and be out of business. While certification may of course mitigate this problem, it is more likely that it will be used in disputes on who is to blame for communication errors: the toll service provider (defective OBE), the toll charger (defective toll system) or a third party (sabotage, e.g. signal jamming).

3.5 Additional common arrangements

3.5.1 Payment

Efficient and guaranteed payments are at the heart of interoperability. In theory, payment of the toll charger can arranged in several ways:

1. Central or onboard accounts.
   Looking to the location where the account is administered we can distinguish on-board account and central accounts.
   An onboard account may e.g. be held on prepaid card (e.g. an electronic purse or limited purpose prepaid card). However, currently no onboard account can be used for all roll systems while driving throughout Europe. There are also no simple regulation procedures when a prepaid card is running out of money.
   Only central accounts seem to be feasible for an EETS.

2. Pre-payment, direct payment, and post-payment
   With respect to time of payment one can distinguish pre-payment, direct payment and post-payment.
   A disadvantage of prepayment is that one may run out of money while the vehicle is driving in a toll domain and there seems no simple procedure to cope with such a situation. Prepayment is therefore not considered for an EETS.
   Direct payment (cash) may be used as an alternative for electronic payment (e.g. in case of an equipment failure) but is outside the scope of this paper. Direct payment by means of a debit card is not yet possible while driving throughout Europe and may also be problematic for GNSS based toll systems in which the fee is incremented in small steps.
   Post-payment may be 'payment' with credit card or based on an invoice or a declaration. It may be used as an alternative at a toll booth. But this is outside the scope of this paper. And, when driving, similar arguments as for direct payment apply.
   In summary, only post payments based on invoices or declarations seem to be feasible for an EETS.

3. From customer to toll service provider and from toll service provider to toll charger, or from customer to toll charger
   Payment from a customer to the toll service provider is a local matter not relevant for interoperability and therefore out of the scope of this paper. For payment from a customer to a toll charger only post-payment from a central account needs to be considered, see above. But in order to make optimal use of the service that can be provided by the toll service provider, post-

[59] A shift in focus from design stipulations to requirements for a 'trusted behaviour' of the OBE may also result in a reduction of the costs of OBE. This however, should still be examined in more detail.

payments from the customer to the toll service provider and from the toll service provider to the toll charger are preferred.

In summary, for the EETS only the payment of toll via the toll service provider seems a feasible option (and not payment directly from the customer to the toll charger). Consequently, the payment of the toll should be a post-payment.[60]

3.5.2 Third party OBE updates

Kinds of OBE updates to be considered are:

1. Data or software updates of the OBE by its toll service provider
2. Third party data updates (e.g. toll regime data by or on behalf of a toll charger)
3. Third party software updates (e.g. by or on behalf of a toll charger)

Data and software updates by the toll service provider can be seen as simple variants of third party (e.g with less complex security requirements[61]).

Note too that software updates by or on behalf of a toll charger require special attention. In that case the toll service provider, that toll charger, and other toll chargers having software on the OBE should trust that the software would be safely executed on the toll service provider's OBE. And, is case of problems it should be possible to make clear who is liable. However, with the current state of the technology this quite a challenge. Mature solutions should not be expected for the first coming years.

Third party software updates also require the specification of an API (Application Program Interface). When the software is to be executed it will require access to other services (e.g. sensors, the user interface, etc) and the API to those other provisions must then be specified completely[62].

OBE updates can be used for non-EFC applications as well. An OBE update protocol should therefore not be restricted to EFC but should be specified for a more generic context.

Conclusions and recommendations: Software updates of the OBE by its toll service provider as well data updates by toll service providers and others should be supported. However, third party software updates requires further (security) study before it should be implemented. In the mean time an API may be defined to prepare its support.

3.5.3 Clearing provisions?

Whether or not and what kind of clearing provisions between toll chargers and toll service providers will pay is unclear[63].

However, it should be noted that (national) arrangements must adhere to EU regulations (see 2.1). In theory there may be one or more (EETS) clearing organisations established. But, if there is more than one, any clearing organisation should be allowed to offer its services for all toll chargers and all toll service providers irrespective of their country of residence.

Note that clearing provisions should not have any impact on the basic interoperability arrangements between toll service providers and toll chargers. A toll service provider or toll charger is only requested to submit or receive information and/or money via a third party (acting as a subcontractor of either the toll service provider or the toll charger).

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[60] This matches with the approach in the Cesare III and other current interoperability projects.

[61] A toll service provider can authorize himself for any OBE update. A third party has to be authorized by the toll service provider for any or particular updates. This may be accomplished with e.g. certificates issued by the toll service provider.

[62] This API was addressed in the MISTER project. These API specifications in MISTER should not be confused with the specifications in the draft ISO 17575 standard. They are completely independent! The latter specifies the provisions for the exchange of software between off-board equipment and OBE, the former the provisions for execution of that software.

[63] In case there are e.g.100 toll chargers and 100 (EETS) toll service providers and, say, 1 transaction per week between a toll charger and a toll service provider, there are only 520 000 transactions a year. And the only clearing benefits seems to be cheaper transaction costs.

Conclusion and recommendation: Although the economic benefit of clearing may be doubted and needs further study, the use of clearing provisions by toll chargers and/or toll service providers should be allowed.

3.5.4 Roaming from toll domain to toll domain

Some toll system concepts require that the OBE of a vehicle roaming through Europe will contact the toll system before or on entering its toll domain[64]. In such cases the OBE should be instructed who to contact where. There are at least two solutions to this problem:

1. the toll service provider is responsible for updating the OBE with this kind of information
2. One can provide some kind of 'directory service' for roaming vehicles

The second option has been chosen in the draft ISO 17575 standard. However the first option seems to be sound as well and, considering the difficulties with the ISO draft, should even be preferable over the first one. Besides, contact information for toll chargers is only needed for beacon-less systems and this information is not expected to change very often.

It should be noted that roaming provisions, i.e. providing the information on which toll chargers should be contacted and where, should be clearly distinguished from the provisions for toll chargers to update OBE[65].

However in case some kind of 'directory service' is provided, there is no need to restrict its use to tolling purposes. A standard for roaming should be useable for other applications as well.

Conclusion and recommendation: EETS may well start without a directory service as proposed in draft ISO 17575. As toll service providers may need probably facilities to update EETS OBE, they may be able to update the contact information for toll chargers as well.

3.5.5 Mitigating the consequences of the subsidiarity principle

As already stated above (see 2.1) EU law allows each Member State and therefore each toll charger to use any tariff scheme he wants to choose.

If been driven to extremes a Member State might suddenly introduce a toll based on a characteristic that must be measured by some new sensor in the vehicle. This would then make all EETS OBE obsolete and new EETS OBE quite expensive. (But then OBE dedicated for the local system might also be expensive).

Any possibility to mitigate the consequences of the subsidiarity principle should therefore be carefully examined.

First it should be noted that proposals to require approval by the Commission and the Regulatory Committee for new vehicle parameters may not be in accordance with the subsidiarity principle as expressed in article 3(2) in the body of the Directive.

Other possibilities are:

1. Advanced announcements of new tariff schemes
2. Allowing more simple OBE
3. Extendible protocols
4. Using officially certified vehicle parameters

New tariff schemes with new vehicle parameters are not introduced overnight. Most often they require a (sometimes lengthy) political decision making process and one also needs time to specify, design, manufacture and test OBE for local use. This may open the possibility for regulations that require the announcement of the use of new tariff schemes, and at least the use of new parameters, well in advance. The length of the period between the availability of OBE suitable for a new tariff scheme and

[64] However, there is still no actual toll system that requires this.

[65] ISO 17575 was criticised for mixing up these provisions and therefore also mixing up the responsibility for their use.

the start of the deployment of that scheme is proportional to the number of existing OBE that need to be prematurely written off.

Second, tariff schemes may also formulate that a fee deduction is allowed (but not mandatory) for certain types of vehicles. EU law only requires that toll regimes shall be non-discriminatory for their users. But it still allows users to select their own OBE. At least theoretically, a user might prefer to use a cheaper OBE at the expense of paying a little bit more in toll domains he almost never visits. On a free market a user should also be allowed to use a cheaper OBE and, as a consequence, pay more fee in some toll domains.

Legally the case may be similar to tax reductions one may, but not have to apply for. By the same token, a vehicle may be allowed (but not forced) to pay a reduced fee if it uses e.g. a particular type of (environment-friendly) fuel.

A user shall then also be allowed to decide to use his old OBE a little bit longer instead of changing any time to the newest 'fully European' OBE.

Example
A French DRSC tag for which it not possible to enter the number of axles may nevertheless be used for CardMe transactions in Austria. In that case toll is levied as if the vehicle had 5 axles.

Third, the use of more easily extendible protocols that can be more easily adapted to new vehicle parameters may also mitigate the subsidiarity problem. This option should however first be examined in more detail.

Fourth, the use of officially certified vehicle parameters may be considered. Instead of requiring a toll service provider to customise OBE by entering all kind of vehicle parameters, one may consider to enter only the registration number or VIN and then rely on a vehicle registration certificate on a smart card[66] or an electronic registration tag (ERT)[67] for additional, and officially certified vehicle parameters. This may reduce the costs for a toll service provider.

Conclusions and recommendations: In order to mitigate the impact of the subsidiarity principle the possibilities of procedural arrangements should be further investigated, the use more simple OBE should be allowed when possible, the extensibility of the communication protocols should be examined and, if necessary, improved, and the use of officially certified parameters should be made possible.

[66] Vehicle registration certificates may also be issued on a smart card, see EU Directive 2003/127.

[67] See draft ISO 24535

3.6 Summary of additional conclusions and recommendations

The additional conclusions and recommendations above are repeated below:

1. Implementation of the VERA 2 or similar proposals is an important step towards a free flow EETS and should therefore be supported. However, the applicability of VERA 2 to civil toll offences still needs to be examined.
2. The market should be encouraged to supply OBE suitable for an EETS or EETS-like service that fits standard into a vehicle and provides standard facilities for its communication with a toll service provider.
3. Harmonisation of the OBE service and maintenance instructions and procedures should be encouraged as well.
4. The concept of SIM card controlled OBE with securely monitoring EFC processes should be further examined and, if proven useful, be supported.
5. Software updates of the OBE by its toll service provider as well data updates by toll service providers and others should be supported. However, third party software updates requires further (security) study before it should be implemented. In the mean time an API may be defined to prepare its support.
6. Although the economic benefit of clearing may be doubted and needs further study, the use of clearing provisions by toll chargers and/or toll service providers should be allowed.
7. EETS may well start without a directory service as proposed in draft ISO 17575. As toll service providers may need probably facilities to update EETS OBE, they may be able to update the contact information for toll chargers as well.
8. In order to mitigate the impact of the subsidiarity principle the possibilities of procedural arrangements should be further investigated, the use more simple OBE should be allowed when possible, the extensibility of the communication protocols should be examined and, if necessary, improved, and the use of officially certified parameters should be made possible.

Annex A. References

2004/52	Corrigendum to Directive 2004/52/EC of the European Parliament and of the Council of 29 April 2004 on the interoperability of electronic road toll systems in the Community (OJ L 166 30.04.2004), OJ L 200, 07.06.2004, p. 50
2005/214	EU Council framework decision 2005/214/JHA of 24 February 2005 on the application of the principle of mutual recognition to financial penalties. (OJ L 76 22.3.2005, p 16)
CardMe-4	The CardMe concept, CardMe-4, Project IST-1999-29053, Deliverable 4.1 (Final) 1 June 2002. (The Cardme transaction has been included in ISO 14906 too)
EG8	Definition of the EFC Application for the EETS Based on Microwave Technologies, Final report, February 6, 2006 Prepared by Expert group 11
EG11	Definition of the EFC Application for the EETS Based on Microwave Technologies, Final report, February 6, 2006 Prepared by Expert group 11
ISO 7498-2	Information processing systems – Open Systems Interconnection – Basic Reference Model – Part 2: Security architecture
ISO 14906	Road Traffic and Transport Telematics — Electronic fee collection — Application interface definition for dedicated short-range communication
ISO 15628	Transport Information and Control Systems (TICS) – Dedicated Short Range Communication (DSRC) – Application layer
ISO 17575	ISO/PDTS 17575:2004 Road transport and traffic telematics — Electronic fee collection — Application interface definition for electronic fee collection (EFC) based on Global Navigation Satellite Systems and Cellular Network (GNSS/CN), 2004-12-17 (However, considering the amount of serious comments on this draft in March 2005 an acceptable new version is not to be expected before 2007)
ISO 24534	Road Traffic and Transport Telematics — Automatic Vehicle and Equipment Identification — Electronic Registration Identification
VERA 2 synthesis	VERA 2 - Synthesis of the main findings of the project and follow-up DG TREN, E4/PH D(2004, Bruxelles, 29 October 2004,
VERA 2 final report	VERA 2 - Video Enforcement for Road Authorities, Final Report September 2004
VERA 2 proposed directive	VERA 2 - Video Enforcement for Road Authorities Deliverable D6-1- Draft Text for a Directive Border Enforcement September 2004

Annex B. Terms, definitions and abbreviations

B.1 Terms and definitions

accepted toll declaration
a toll declaration that is not contested by the toll charger

NOTE: A valid tolling declaration may still contain incorrect data, e.g. a wrong declared parameter or a wrong vehicle location.

actor
a person or legal entity who performs or takes part in any action; a doer.

central account
an account that is kept and administered off-board.

contract issuer
CEN TC278/WG1 term for toll service provider, see toll service provider.

customer (of a toll service provider)
a person or legal entity who uses the service of a toll service provider.

NOTE Depending on the local situation the customer may be the owner, lessor, lessee, keeper, (fleet) operator, holder of the vehicle's registration certificate, driver of the vehicle, or any other third person.

driver
a person who drives a vehicle.

NOTE The driver is assumed to operate (use / serve) the OBE (e.g. the setting of the number of axles).

EETS (European Electronic Toll Service)
a toll service for all toll domains under the operation of Directive 2004/52.

EETS provider
a toll service provider providing toll services for all toll domains under the operation of EU directive 2004/52.

EFC Operator
CEN TC278/WG1 term for toll charger, see toll charger

electronic fee collection (EFC)
toll charging by electronic means via a wireless interface.

NOTE The actual payment (collection of the fee) may take place outside the toll system.

enforcement
the process of compelling observance of a law, regulation, etc.

NOTE In this context: the process of compelling observance of a toll regime.

equipment interoperability
the ability of two or more pieces of equipment to operate in conjunction

interoperability
the ability to operate in conjunction (see the SOED)

non-repudiation
in this context, the property that neither the toll service provider nor the toll charger can deny in all or in part the participation of their OBE respectively toll system in a communication (see ISO 9498-2)

onboard toll equipment (OBE)
equipment fitted within or on the outside of a vehicle and used for toll purposes.

NOTE 1 The OBE does not need to include payment means.

NOTE 2 See also onboard toll unit

onboard toll unit (OBU)
onboard toll equipment assembled in one monolithic device.

one(s) liable for toll
person(s) or legal entities liable to pay toll under the operation of a toll regime.

NOTE A toll regime may designate more than one person to be (jointly and severally) liable for the paying the toll.

operator
Directive 2004/25 term for toll charger, see toll charger

organisational interoperability
the ability of two or more organisations (persons or legal entities) to operate in conjunction

NOTE the ability of organisations to operate in conjunction includes, if applicable, the interoperability of their equipment.

toll
a charge, a tax, or a duty in connection with using a vehicle within a toll domain

TEMP NOTE The definition is generalization of the classic definition of a toll as 'a charge, a tax, or a duty for permission to pass a barrier or to proceed along a road, over a bridge, etc.'. The definition above also includes fees regarded as an (administrative) obligation, e.g. a tax or a duty.

toll charger
a person or legal entity charging toll for vehicles in a toll domain

TEMP NOTE Directive 2004/52 uses the term operator and sometimes road toll charger. Cesare III has proposed the tem toll charger instead and CEN TC278/WG1 uses the term EFC operator.

toll declaration (from OBE)
a statement (from the OBE of a vehicle) to a toll system confirming the presence of a vehicle in a toll domain in a format agreed between the toll service provider and the toll charger

NOTE A valid toll declaration has to the fulfil formal requirements, including security requirements, agreed between the toll service provider and the toll charger.

toll domain
an area or part of a road network where a toll regime is applied.

toll regime
the set of rules, including enforcement rules, governing the collection of toll in a toll domain.

toll scheme
a generic term used for toll regime and/or toll domain and/or toll system depending on the context.

toll service
a service enabling users having only one contract and one set of OBE to use a vehicle in one or more toll domains.

toll service provider
a person or legal entity providing to his customers toll services on one or more toll domains for one or more classes of vehicles.

NOTE 1 The toll service provider may provide the OBE or may provide only a magnetic card or a smart card to be used with OBE provided by a third party (like a mobile telephone and a SIM card can be obtained from different parties).

NOTE 2 The toll service provider is responsible for the operation (functioning) of the OBE.

toll system
the off board equipment and possible other provisions used by a toll charger for the collection of toll for vehicles.

NOTE 1 The OBE is excluded from the definition. If not, OBE should be part of any toll system for which it may be used.

NOTE 2 The actual payment (collection of the fee) may be take place outside the toll system.

tolled object
a distinguished part of a toll domain.

NOTE A tolled object may be e.g. a bridge, a zone, or a stretch of a road (network).

user
a generic term used for the customer of a toll service provider, one liable for toll, the owner of the vehicle, a fleet operator, a driver etc. depending on the context.

valid toll declaration
a toll declaration that provides the toll charger with a valid claim for the fee on the toll service provider and/or its customer.

NOTE Valid communications has to fulfil formal requirements, including non-repudiation requirements, agreed between the toll service provider and the toll charger.

B.2 Abbreviations

CEN	Comité Européen de Normalisation
DSRC	Dedicated Short Range Communications
EETS	European Electronic Toll Service
EGNOS	European Geostationary Navigation Overlay Service
EU	European Union
GNSS	Global Navigation Satellite System
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Originally Groupe Speciale Mobile, now Global System Mobile
HGV	Heavy Goods Vehicle
OBE	Onboard Equipment
SOED	Shorter Oxford English Dictionary