DIRECTIVE 2004/52/CE on Interoperability of Electronic Fee Collection Systems in Europe

Recommendations on enforcement specifications and technologies for the European Electronic Toll Service

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Expert Group 10: Functional requirements and technologies for enforcement of violations in non-stop environment
working to support the European Commission DG TREN

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1 EXECUTIVE SUMMARY

In order to define the European Electronic Tolling Service, EETS, specified in the Directive 2004/52/CE, the European Commission launched a set of initiatives to cover the most relevant aspects of this new service. Amongst these, several Expert Groups were created, including Expert Group 10.

Expert Group 10 (EG10) was made responsible for the definition of the functional and technological specifications for the enforcement system of the future EETS, focusing on cross-border aspects, and on internal issues driven by cross-border needs. Although EETS enforcement deals essentially with cross border interfaces, enforcement is indeed a national issue, an essential mechanism to minimize loss of revenue for toll operators. It is fundamental that EETS countries have, as much as possible, a common language and practice in terms of enforcement, and that each follows standard and reliable practices enabling a reciprocal trust in actions that one is requested to undertake based on information acquired and processed by EETS actors in different countries. These are the main reasons why the authors of this report have decided to get in so much detail concerning these issues that one could consider irrelevant in terms of cross border enforcement.

Although in different other fora working on the definition of the EETS, the violation committed by vehicles with no EETS contract is not usually covered by EETS enforcement procedures, this expert Group believes that the topic of Offenders without an EETS Contract should be covered in this document. Whenever possible, namely when the national legislation allows and EETS actors are willing to cooperate, we believe that EETS actors across the borders are the best possible alliance to identify and pursue those who violate the correct use of the EETS service. Nevertheless, we accept that the level of commitment between EETS players may not be the same as for those violations committed by vehicles with a valid or for some reason momentarily suspended EETS contract.

This final report is supported by three documents produced in 3 different task forces covering the following aspects:

- Current EFC and Enforcement systems implemented across Europe and foreseen developments
- Identification and analysis of the possible situations of violation that can take place in an interoperable environment and the proposed procedures for its resolution
- Analysis of the available enforcement technologies and their application to the fulfillment of the enforcement requirements

The main conclusions achieved by the three task groups are hereafter summarized.

Most of the EFC systems implemented across Europe are supported by DSRC technology, assisted by other electronic systems for local and/or remote management of transactions and detection and treatment of anomalous situations.

In respect with enforcement, many of these DSRC based EFC operations make use of lifting-bars, which for the time being are considered by those using them as the unique effective enforcement mechanism due to the absence of appropriate legal framework to cover toll violations. The deployment of completely free flow systems raises new requirements for new enforcement methods and technologies. OCR and LPR systems are becoming more and more utilized, assuming special relevance to the identification of vehicles, and the constitution of evidence of those violations. However, some countries still face privacy restrictions on the usage of these mechanisms as constitution of evidence.

In real multilane free-flow systems used in the coverage of open road networks, the correct use and functioning of the OBU is the basis of the charging system and essential for the enforcement process. Since real free flow systems are pointed out as having the advantage of less interference with traffic flow, when defining the applicable enforcement solutions one should avoid jeopardizing this same advantage. In these systems we may have to accept the fact that enforcement will not cover 100% of the traffic. In order to guarantee a low level of violation under a scenario where only a fraction of traffic is enforced, high penalties and/or fines shall be applicable to those violating. A clear signal must be given to those violating, showing that in the long term violating is too risky and not worth being committed. Road Users must have the perception that enforcement may take place anywhere at any time and that quick action will be undertaken against those violating. Therefore, for these real free flow systems the combination of fixed and mobile enforcement is pointed out as the most efficient way. Efficiency and cost of mobile enforcement are quite new issues requiring detailed analysis.

	PROS	**CONS**
Stationary Enforcement at gantries or channelized toll plazas	• Lower Operation / maintenance costs • Covers all traffic through gantry or toll plaza • Use of more mature and manageable technologies	• Less effective as being expected at fixed spots
Mobile Enforcement	• Effective as being expected anytime, anywhere on the tolled network • No impact on mobility for those vehicles complying with the toll scheme	• Higher operation /maintenance costs • Covers only a sample of the traffic (approx 10%) • Performance issues still to be validated

Table 1 – Advantages and disadvantages of fixed and mobile enforcement.

Due to a lack of national legal framework to detect, record and pursue violations, most concessionaire toll operators are not very optimistic about future developments to come, and specially when these violations will be committed by non-national citizens, some of them coming from countries outside Europe. Removing lifting bars without law enforcement mechanisms, even with most advanced enforcement technology in place, is a scenario not acceptable by most DSRC toll operators. We believe that this is a lucid position from most transport service providers (TSPs) that must be dealt with if we look for a global free flow EETS.

When asked about national or European changes foreseeing the implementation of the EETS service and respective definitions carried through in the scope of the CE/2004/52 Directive, most entities point out essential required modifications at the technological level (namely as far as the constitution of evidences is concerned) and at the legal and regulation level (namely, regarding the creation of conditions that allow a fast and effective recovery of the values in debt – including toll charges and penalties/fines).

In order to specify the functional and technological requirements of the EETS enforcement system, an exhaustive identification of possible violation situations, covering both the DSRC and GNSS systems was undertaken. These situations are detailed and analyzed in the present document, and fit, in conclusion, in six main groups: No OBU or Receipt of Booking System; Discrepancy between declared and determined parameters for attribution of tariff's class; Equipment malfunction; Route Inconsistencies; Attempt to inhibit the payment/enforcement and Others.

Different enforcement technologies available on the market were assessed in terms of performance, cost and how they fit towards expected enforcement requirements of EETS. All identified technologies are supplied by more than one vendor and/or described by open standards. Known vendors were listed and available information about their products was taken into account in the production of this report. Information from European Projects, Certification and Audit Agencies was also taken into account.

After analyzing the possible and most relevant enforcement situations, defining the applicable functional procedures and the adjusted technologies, a set of recommendations was established aiming to be a starting point for the discussion among EU state-members. These recommendations have two essential intentions: on one hand, to guarantee the prevention of the occurrence of violations; on the other hand, to implement effective mechanisms for the detection, recording, processing and regularization of those violations, when and where they occur.

As far as prevention is concerned some basic principles are proposed, namely, the obligation to have an alternative charging system especially for non-equipped vehicles, e.g. the occasional users appropriate signaling of EETS lanes, uniform service usage rules amongst EETS countries, availability of alert signals on the OBU so that the User can have real time information on the occurrence of anomalous situations, and the inclusion in the EETS contract of explicit clauses that compel the users to have a compliant behavior.

Regarding the mechanisms for regularization of the violations, the listed recommendations are related to three essential issues: the identification of the violator (for instance, through the search on adherents' databases or in databases of national registry of vehicles – directly or through authorities), the identification of the vehicle (essentially through the use of photographic means, OCR and LPR) and the creation of the legal framework that promotes the resolution of these irregularities with resource to courts and other institutional entities on a full pan-European scale across states participating in EETS - even those that are not members of the EU (e.g. Switzerland or others).

Another issue identified on the recommendations is the relation between state-members in the scope of the EETS. Guidelines have been created which intend to guarantee the settlement of a common basis of understanding among them (through the creation of a MoU) and the existence of an efficient means of communication and data exchange.

2 ANALYSIS OF THE CURRENT SITUATION AND PLAYERS REQUIREMENTS

In the scope of the current report, a questionnaire was elaborated aimed at the TSP´s of the different European countries that members of the Expert group have been able to reach in the time frame of this initiative. This questionnaire was intended to obtain a characterization of the current EFC environment and enforcement systems of the enquired entities, as well as to obtain a set of trends and requirements that may be appropriate for the functional and technological definitions that will be established throughout this report.
A total of 12 TSP's answered the enquiry. The full result of these collections of contributions and the respective details can be found in appendix *6.2 - Current EFC and Enforcement Systems Analysis*.

Based on the above mentioned enquiries it is worth saying that most countries operate both through the manual and electronic tolling schemes, but the manual system is still prevailing. However, there are extreme situations both with respect to the means used and to the tolled infrastructure. For example, in Greece toll payments are mostly manual and in Austria, all heavy goods vehicles (HGV's) are obliged to make use of an electronic tolling system based on DSRC technology. In Portugal, where the EFC is not mandatory neither for HGV´s or private vehicles, approx. 62% of the transactions are performed through the national EFC system called Via Verde.

In all these countries that answered the enquiry, with the exception of Germany, the Microwave 5,8GHz DSRC technology dominates the toll collection system. Today, in the German system (operated by Toll Collect) an infrared carrier is used (IR DSRC) mainly for enforcement purposes but also localization support. The majority of TSPs enquired, at the time of the survey, are concessionaires who were found to be satisfied with Microwave DSRC technology and showed no will to change their current technological infrastructure. The current enforcement infrastructure is fit with detection means that are essentially based on the use of video cameras, OCR, LPR and VCE. Currently most of the violations are detected via electronic means (and not directly by toll gate supervisors). However, first examples of multi-lane free-flow tolling were also covered (e.g. Austria and Germany) which show different needs for enforcement. Other vehicles are not stopped immediately after the detection of the violation but are later pursued following a backoffice process.

The violation rates recorded, seem to be very low, mainly on traditional systems. The "piggy-backing" seems to be the most common intentional violation together with unsolved invoices. However, it is necessary to take some caution in the assessment of these values, since all DSRC operators that answered this question considered that in their toll collect/enforcement system, the presence of lifting bars is a key element in limiting the number of violations. If we consider that in the 2004/52/CE Directive, the use of immaterial barriers is encouraged, it seems very likely then that by complying to this requirement, without further legal and procedural developments, the number of violations could grow considerably. In real free-flow tolling as that practiced in Austria, Germany and Switzerland, only samples of the full traffic are checked for toll violations. In some of these situations the vehicle in question is stopped by officers so that charges and fines can be secured on the spot, but others are treated in back office and pursued later.

In tolling systems based on an autonomous OBU using GNSS/CN (the transaction is calculated and stored in the OBU for later transmission to a Central System), special attention must be paid to the correct functioning of the OBU. Since this OBU is outside the physical control of the CI and/or the TSP, tampering detection mechanisms are of fundamental importance. In order to hold the User responsible for the correct use of the OBU, the HMI shall assure that he is informed of the status of the OBU and preferably of declared vehicle parameters. In what enforcement is concerned it is recommended that all OBU status changes are recorded in a log that may later be used as evidence, e.g. as evidence for non compliant declaration of parameters. Well defined subsets of this data must be made available via short range interface for enforcement purposes to the RSE or mobile enforcement (if applicable). Due to the sensitive nature of this data, privacy must be ensured and access must be limited to authorized personnel only. For this purpose, well defined protocols with

- authentication of the OBU and it's issuer as well as
- authentication and authorization of the enforcement data requestor
- data encryption to secure system integrity and privacy and to ensure correct content and sender

based on robust cryptography should be implemented. For this, also a well defined role model and an aligned cryptographic key infrastructure that incorporates all EETS participants in their different roles should be defined and implemented.

The reported number of violations of foreign vehicles (European or otherwise) is variable from country to country, but it seems to be strongly dependent upon distance of the concerned road from border. For instance, in Italy the bordering Autostrada dei Fiori reaches 52% of violations from foreign drivers, where SATAP in the flat of Po river (northern part of Italy) reaches 28%, while Autostrade per l'Italia that has a wider network that includes the most important North-South Italian connections is still on a rate of 22%. The Spanish concessionaire Cintra, in the central part of Spain, has negligible percentage of violation from foreign drivers. An extreme case is the Austrian, where 84% violations are attributed to foreign drivers. This is probably explained by the reduced dimensions of the country (all territory under influence of national borders) and by the fact that OBUs are mandatory for HGV's. It is most probable that the violations are committed by foreign drivers because of less service information. From the collected data, it also seems that there is an important number of violations resulting directly from the fact that local cross-border users are aware of restrictions in administrative cross border enforcement and have a deep feeling of impunity when they violate tolling services in the foreign country.

The procedures used in the recovery of values resulting from situations of violations seem to be similar in the various countries under analysis. The offender with a national citizenship, is notified via letter/mail of the amount in debt, and is informed of acceptable alternative procedures for the regularization of the situation. Depending on the country where the offence took place, the value in debt may or may not include fines or administrative costs. In case the offender fails to pay the debt within the time frame and conditions specified and communicated and/or it is verified that the offender persists in committing violations, a process is initiated so that the situations may be dealt with in a civil or criminal court. In case of a foreign offender, due

to a lack of legal framework for cross border enforcement, or lengthy and costly (compared to the amount to be recovered) procedures, no action is undertaken in order to recover the debt.

In very few exceptions there is a legal framework for cross border enforcement but it seems to be quite inadequate taking into account the needs of the EETS service. In the majority of these exceptional countries, violations are handled by empowered entities such as police and courts, but with heavy administrative overhead that makes it inefficient for the debt recovery, in some cases a quite low value. However, in some countries the main goal may not be the recovery of an open debt, but rather to deter from violations by applying high penalties/fines. A combination of considerable high risk of being caught with the high value of penalties/fines may be an important factor to minimize violations.

With respect to the predicted modifications in terms of enforcement, many of the TSP's refer to the technological infrastructure installed. In order to improve the technological means currently installed (such as the case of Portugal, where it is expected that the video cameras will begin to capture images of the rear-side, as well as the front of the vehicle), some TSPs foresee the installation of new equipment to increase the efficiency of the enforcement (such as video cameras and LPR) and the credibility of the EFC system as a whole. Nevertheless, countries like Germany or Greece predict an adjustment of the respective legislation so that it may possibly take into account toll violations, the means for its detection and recovery of the value in debt.

Specifically with respect to the enforcement applied on non-national citizens, the various countries intend to follow the procedures established in the scope of the 2004/52/CE Directive, and all of them are pointing out the necessity of establishing bilateral or European level agreements among public entities (transport ministry, ministry of interiors…), traffic authorities, TSP's and entities responsible for licence plate registration and for the creation of supra-national regulating entities.
Although they acknowledge the advantages with respect to traffic flow, the countries that currently employ physical barriers in their EFC system show themselves very reluctant to remove these same barriers. They all put forward as a critical condition the clear definition of violation and the establishment of the legal scope for toll violations, for the penalty of the offenders (national or non-national) and for the recovery of the values in debt. This definition should be accepted and effectively applied in all member states, in order that the enforcement system may guarantee that the TSP will not be penalized.

3 ENFORCEMENT TECHNOLOGIES ASSESSMENT

In order to present all available technologies associated with the enforcement process, firstly the building blocks of a generalized enforcement system have been identified. The enforcement process covering autonomous and non-autonomous schemes can be described as a progression through sub-functions as described in the following diagram.

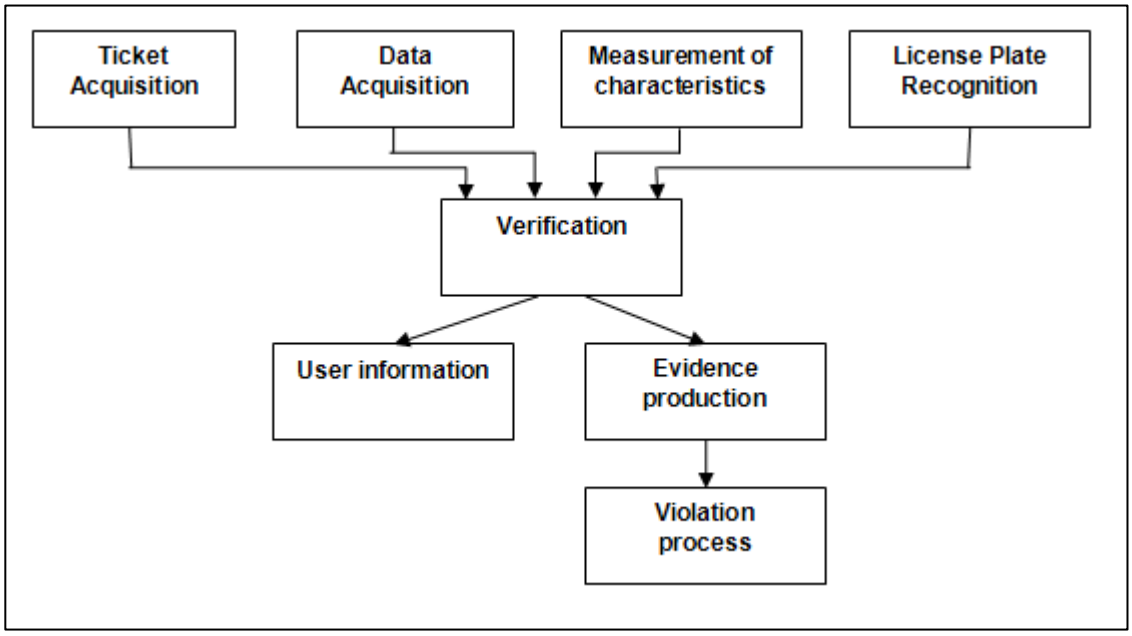


Figure 1 – Enforcement process.

EG10 then identified available technologies serving each particular enforcement block. Recognizing the national legal frameworks as well as the right of each operator to enforce by an appropriate method of his choice, both mature (proven) as well as state of the art technologies were illustrated, covering free-flow multi-lane and single-lane toll concession layouts. All mentioned technologies presented in terms of performance and cost efficiency can support and/or enrich the EETS service.

Data (or ticket) acquisition can be achieved through dedicated wireless communications such as DSRC based on 5,8GHz MW or IR, visual inspection, database querying, at the road-side or on the back-end side.

The design of the enforcement system for the ticket acquisition depends strongly on the location of the stored ticket. In a booking system the ticket is stored in a Central System. In an OBU (DSRC, GNSS/CN) based charging system a direct link between enforcement equipment and OBU is needed in order to retrieve relevant data (ticket, OBU status, etc).

In DSRC based charging schemes the enforcement process is usually linked to the charging system, leading to synergies (same location, same gantries, same power feeding equipment, same communication links,

etc). In GNSS/CN based systems the situations is quite different. The OBU being an autonomous device in terms of charging allows for virtual charging locations in what RSE is concerned. In order to avoid the deployment of enforcement gantries a bet was made in mobile enforcement. This mobile enforcement must theoretically cover all roads at any time so that users may not have determined fraudulent behaviors. The first step in mobile enforcement will be, without stopping the vehicle, to read the enforcement record from the OBU and by checking the OBU´s settings in terms of semi-permanent declared vehicle parameters and those declared through the HMI interface. Declared parameters are checked against values obtained by local measurement (without stopping the vehicle), visual inspection and through access to central data bases. Only in case of OBU malfunction or discrepancies on declared parameters may the mobile enforcement unit decide to securely stop the vehicle.

The tables presented below summarize the performance and costs analysis of technology assessment performed by the Expert Group. We wish to emphasize that information presented reflects the situation today and that the dynamics of the market and further technical developments may implicate considerable changes in the close future. The figures presented result from several enquiries made to several suppliers and toll operators.

	The expert group's estimate of the reliability of ALPR systems, as percentage of successful recognitions	*An example of deployment costs per lane, as quoted by a major supplier of the technology. The example does not include cabling, trigger, or installation costs.*	*The expert group's estimate of yearly maintenance cost, as percentage of deployment cost*
InfraRed ALPR System (with IR flash)	90%-95%	€ 7000	10%-100%
Visible range ALPR System (with constant blue illumination)	85%-90%	€ 4500	10%-100%

Note:

Yearly maintenance cost mainly depends on whether cameras can be cleaned without closing of the lanes.

Current cameras need to be cleaned about twice per year. In case a walkable gantry is installed and legislation allows using it, yearly maintenance cost can be about 10% of deployment cost. Otherwise yearly maintenance can reach 100% of deployment costs because of high lane closure costs.

Figure 2 – Performance and costs analysis for ALPR systems.

	The expert group's estimate of dedicated wireless communication systems' reliability range, as percentage of successful transactions	*An example of deployment costs per lane including one transceiver beacon and one lane controller, as quoted by a major supplier of the technology. The example does not include cabling or installation costs.*	*The expert group's estimate of yearly maintenance cost, as percentage of deployment cost*
CALM InfraRed	99.98% (certification) -99.99% (supplier estimate)	€ 6000	8%-10%
CEN MicroWave	99.5% (certification) -99.99% (supplier estimate)	€ 7000	8%-10%
TelePass MicroWave	99.9% (certification) -99.99% (supplier estimate)	€ 8000	8%-10%

Note: The cost of equipping mobile enforcement vehicles is not directly comparable to the per-lane costs of fixed installations.

Equipping of a mobile enforcement vehicle with dedicated wireless communications costs 25 000 euros for data processing equipment per vehicle in TollCollect case, plus cost of mobile mounted transceiver beacon, which is estimated by Efkon to cost 5000 euros. Operating a mobile enforcement vehicle is estimated to cost 30 000 euros per vehicle per year plus one or two operating personnel costs per vehicle. Reliability is same as in fixed installation case.

Figure 3 - Performance and costs analysis for wireless enforcement communication technologies.

	The expert group's estimate of classification systems' reliability range, as percentage of successful classifications for an average scheme	*The expert group's estimate of deployment cost range per lane, including installation costs.*	*The expert group's estimate of yearly maintenance cost, as percentage of deployment cost*
Video Classification	88%-92%	€ 4000 - € 5000	6%-10%
Laser Scanner	95%-99.5%	€ 5000 - € 7000	6%-10%
Loop Detector	90%-95%	€ 1000 - € 2000	10%-15%
Pressure Sensor	70%-80%	€ 500 - € 1200	10%-20%

Note: Reliability of a classification technology is strongly dependent on the scheme requirements.

In case classification needs to distinguish e.g. buses from trucks, video or laser scanner based classification will perform near high end of indicated range, while loop and pressure sensor based classification will perform near low end of it.

In case classification needs to distinguish e.g. axle numbers, laser scanner based classification will perform near low end of indicated range, while loop and pressure sensor based classification will perform near high end of it.

Figure 4 - Performance and costs analysis for vehicle classification technologies.

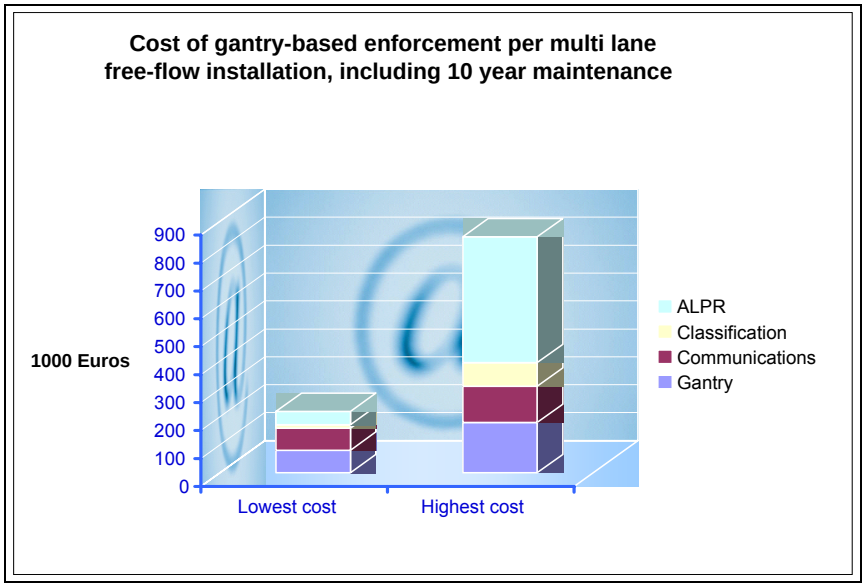


Figure 5 – Cost of gantry-based enforcement per multi-lane free-flow installation.

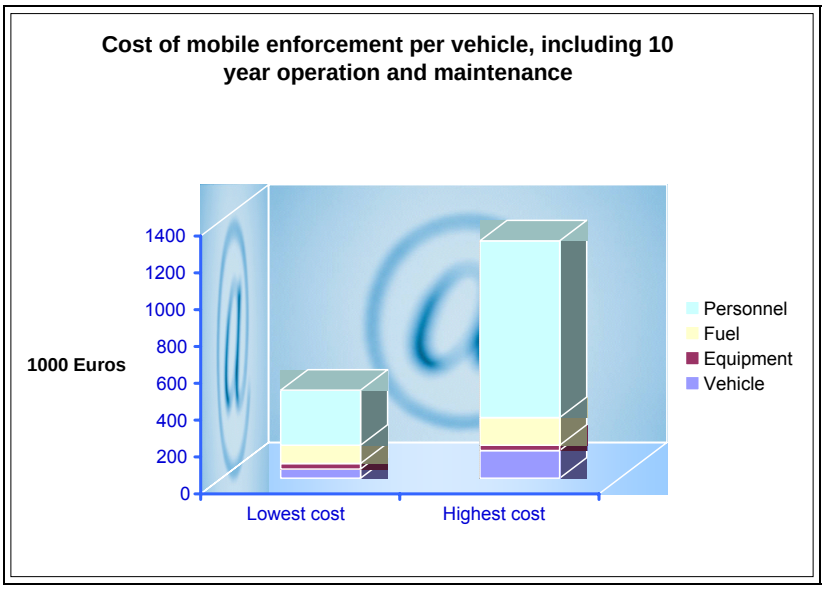


Figure 6 – Cost of mobile enforcement per vehicle.

The main task of enforcement is to assure the TSP that fees are collected and in the correct amount taking into account those characteristics of the vehicle that are relevant to the tariff class attribution. The vehicle characteristics relevant for the determination of the applicable tariff class will usually be stored on the OBU on in case of a Booking System in Central Data Base. At the enforcement location these declared vehicle parameters have to be confirmed against those exhibited by the vehicle.

Under the scope of ETTS enforcement, in the communication of stored data in the OBU, the combination of utilized communication technologies should effectively and reliably supported both mobile and gantry-based enforcement schemes.

In terms of measurement of vehicle characteristics for the purposes of enforcement we should keep in mind that of the nine EFC attributes defined in CEN TC278, only four could possibly be measured in free flow, namely LP number, dimensions, number of axles (with possibility to differentiate between lifted and on-the-ground axles), and laden weight. Moreover, new charging policies based on environmental parameters, such as emissions and road friendly suspension is being encouraged by the EC. Currently, there is no feasible method of measuring such vehicle characteristics on the spot.

Given that EETS encourages free-flow systems, four classification technology alternatives have been identified that can be used for enforcement purposes, namely: (a) video (or image processing) classification, (b) laser scanners, (c) inductive loops and (d) pressure sensors. The first two are non traffic intrusive, require less maintenance costs, but suffer from spatial occlusion, especially in pole mounting, and varying illumination conditions (e.g. fog, heavy precipitation, shadows). Infrared technologies with active lighting /LED flashes can help better lighting conditions. Loops and pressure sensors, even if being traffic intrusive and susceptible to stresses of traffic and temperature, are still a good choice with axle numbering schemes mainly in single lane environment. Besides, they are cost effective (at least as an initial investment), and are considered mature and well-understood technologies.

In terms of performance laser scanners, image processing and inductive loops are at the top of the list for free flow monolane, but as we move to multilane, loops cannot be considered. However, we do not expect to forget intrusive technologies any time soon. If axle numbering schemes are preserved, loops can be used in combination with non-intrusive technologies that lack axle numbering capabilities (e.g. overhead gantry mounting).

Although optionally implemented, License Plate Recognition (LPR) provides, at some specific confidence level, the license plate of the passing vehicle, given the image(s) acquired. LPR inherently serves both the verification process that follows (e.g. look-up in an authoritative database for true registered vehicle characteristics or look-up of valid tickets in case of booking systems) and the evidence production process.

Latest developments in Automatic License Plate Recognition systems also indicate that success rates under best conditions are currently exceeding 80% (without infrared flashes and cameras), and reach approximately 90% (or more) when employing infrared flashes and cameras, thus alleviating adequately the costly backoffice manual intervention. But even if LPR technologies advance rapidly, inherent drawbacks such as vehicle occlusion, variations in fonts (letters and numbers, character sets, etc.), variations in reflective materials and LP decay, makes fully automated LPR impossible to achieve a desired 99% success rate, under any circumstances. Therefore visual inspection of some automatically recognized license plates may still be be needed. These are the reasons behind studies and standardization efforts for Electronic Vehicle Identification (EVI) for tolling and other telematics applications as well.

Measured characteristics along with the optional LPR outcome must be compared with data acquisition information to verify that a particular vehicle has completed a valid transaction. Back-office internal checks may also come up with discrepancies. In case of inconsistency, further action is required and a signal must be passed to the evidence production sub-system. Assuming that all the required information is available, this is a simplistic task, not involving specialized technologies.

Keeping the driver informed about the outcome of the verification (enforcement) process, while at the charging spot, or at the charging area, or even back home, is a crucial part of any tolling scheme and thus also of the EETS. Keeping users substantially aware may considerably alleviate the work-load of the violation process. This can be achieved by conventional displays at the road for the purposes of static enforcement (for monolane traffic), as well as through OBU HMI. SMS messages can serve this purpose while at the effective charging area, whereas periodic invoices and the internet can be employed for user information back home.

Although it is fundamental that OBU costs are maintained as low as possible, in terms of HMI technologies a lot is expected to change in the near future. The majority of installed OBUs in European cars currently merely have some LEDs and a buzzer. Some more fit in a switch for trailer or axle declaration when such claim affects the charging scheme. But now touch screens and pictogram displays are proliferating, whereas speech synthesis and recognition are more realistic options. All such technologies evidently improve drivers' awareness, implying however the integration of OBUs into vehicles, mainly because of OBU power consumption among other reasons suggested by Expert Group 6 (EG6).

Capturing a proof of passage is crucial for the prosecution process. Many data generated in different functions such as charging, verification and enforcement can be used. Usually an image of the vehicle combined with various metadata such as LPR outcome, location, date, etc. is used in the violation process. The complete data set must contain all relevant items of the violation, e.g. ticket/receipt, number of axles, license plate, trailer presence, etc. The definition of the evidence required is strongly dependent on the classification scheme used and on legal requirements applicable to the prosecution of the violation.

Elements of the evidence may reside in RSE, the back office or the EOBU as standardized log files. Involved technologies are related to safely storing and transmitting the evidence, preserving its integrity, authenticity and confidentiality. These are mainly cryptographic techniques equivalent to e-commerce such as hashing and encryption algorithms (RSA/AES, SHA, etc.). All these, along with the necessary procedures and key handling are efficiently covered by the VERA2 deliverables.

Any vehicle that is found, through enforcements means, to be using the road without appropriate payment should be dealt with. The mechanics of the violation process is not a technical issue. However, all the above-mentioned technologies work mainly towards the direction of alleviating the workload of the costly and sometimes meaningless cross-border violation prosecution.

4 ENFORCEMENT FUNCIONALITIES VERSUS APPLICABLE TECHNOLOGIES

4.1 Possible Situations Analysis

This chapter covers the identification of the possible EETS violations that may take place and the possible preventive/prosecutive enforcement action that currently available enforcement technologies support. Although the EETS OBU may, in terms of enforcement, support CEN DSRC, Telepass DSRC and InfraRed, it is admissible that due to OBU cost control and taking into account the reality of infrastructure currently deployed, that simpler OBU´s are made available which will cover the requirements of specific regions in Europe, thus allowing lower costs to those users which may express the need to a limited cross-border usage. Enforcement functionalities may vary between these EETS On-Board Unit types - this table refers to the two types of OBUs proposed in what enforcement is concerned:

- OBU with low cost enforcement interface – enforcement communications are based only on CEN DSRC
- OBU with complete set of enforcement interfaces – enforcement communications support a combination of CEN DSRC, TelePass DSRC, and ISO CALM InfraRed based enforcement.

The identified situations are described in the following table, where only entries at relevant match between violation type and EFC technology type are filled in.

SITUATION	TYPE OF INSTALLED EFC TECHNOLOGY				
	DSRC MONO-LANE	DSRC MULTI-LANE	GNSS-CN	BOOKING SYSTEM	TACHOGRAPH
NO OBU / RECEIPT OF BOOKING SYSTEM					
No OBU	Prosecution through automated license plate recognition and vehicle classification.				Prosecution through automated license plate recognition and vehicle classification.
Vehicle without OBU and not registered in the Booking System	Prosecution through automated license plate recognition and vehicle classification.				
License plate number registered in the OBU does not meet the real one	Prosecution based on received mismatching data.				Prosecution based on received mismatching data.
License plate number registered on the Booking System different from the one read				Manual verification is required to ensure that no incorrect fines are issued for the fault of license plate recognition system	
Discrepancy between the declared and the determined parameters that define the vehicle tariff class	General approach: prosecution based on comparing received data from OBU and classification equipment.				
Number of axles declared in the OBU or in the booking system different from the one determined by enforcement system	Classification equipment at fixed installations supplies axle data – video classification is most generally applicable. Pressure sensor or loops are useful only in case when raised axles do not count in the enforcement scheme. Local prosecution by mobile enforcement vehicle is also possible.				

SITUATION	TYPE OF INSTALLED EFC TECHNOLOGY				
	DSRC MONO-LANE	DSRC MULTI-LANE	GNSS-CN	BOOKING SYSTEM	TACHOGRAPH
(Legal Maximum laden) Weight of the tractor unit declared in the OBU or in the booking system different from the one determined by the enforcement system	Local prosecution by mobile enforcement vehicle is possible. At these enforcement spots access to central data bases (CI, TSP, National Authorities) or alternatively registration documents can be checked. Otherwise classification equipment at fixed installations provides weight estimation – laser scanners or video classification is applicable for the estimate, weight-in-motion equipment of certified accuracy is applicable for free-flow measurement.				
(Legal Maximum laden) Weight of the trailer declared in the OBU or in the booking system different from the one determined by the enforcement system	Local prosecution is possible by comparing OBU data to visual inspection from mobile enforcement vehicle. At these enforcement spots access to central data bases (CI, TSP, National Authorities) or alternatively registration documents can be checked. Classification equipment at fixed installations provides weight estimation – laser scanners or video classification is applicable for the estimate, weight-in-motion equipment of certified accuracy is applicable for free-flow enforcement measurement.				
(Legal Maximum laden) Weight of the combination (tractor and trailer) declared in the OBU or in the booking system different from the one determined by the enforcement system	Local prosecution is possible by comparing OBU data to visual inspection from mobile enforcement vehicle. At these enforcement spots access to central data bases (CI, TSP, National Authorities) or alternatively registration documents can be checked. Classification equipment at fixed installations provides weight estimation – laser scanners or video classification is applicable for the estimate, weight-in-motion equipment of certified accuracy is applicable for free-flow enforcement measurement.				
Type of suspension is different from the one registered in the OBU or in the booking system	Local prosecution is possible by comparing OBU data to visual inspection from mobile enforcement vehicle. At these enforcement spots access to central data bases (CI, TSP, National Authorities) or alternatively registration documents can be checked.				
Type of fuel is different from the one registered in the OBU or in the booking system	No free-flow inspection is possible. Only possible assurance is a secure data storage of this parameter in the OBU, accessible through a controlled procedure. At any mobile enforcement spot access to central data bases (CI, TSP, National Authorities) or alternatively registration documents checking can be a supporting tool.				
Emission class is different from the one declared in the OBU or in the booking system	No free-flow inspection is possible. Only possible assurance is a secure data storage of this parameter in the OBU, accessible through a controlled procedure. At any mobile enforcement spot access to central data bases (CI, TSP, National Authorities) or alternatively registration documents checking can be a supporting tool.				

SITUATION	TYPE OF INSTALLED EFC TECHNOLOGY				
	DSRC MONO-LANE	DSRC MULTI-LANE	GNSS-CN	BOOKING SYSTEM	TACHOGRAPH
Dual-tire vehicle condition is not properly recorded in the OBU	No free-flow inspection is possible. Only possible assurance is a secure data storage of this parameter in the OBU, accessible through a controlled procedure.				
EQUIPMENT MALFUNCTION					
Problems in OBU reading and Communication Interference between the RSE or Mobile Enforcement equipment and the OBU	These situations can be enforced through automated license plate recognition and vehicle classification. Identifying that the license plate belongs to a vehicle with a valid EETS contract, a normal transaction can be performed (problems may occur in DSRC closed systems where the entrance is not known, although it can be overcome by installing LPR systems at entrance and exit lanes)				
No success in storing the entry toll code in the OBU	Back-office system should retain this information and resend it to the OBU at the toll exit point.				
OBU receiver malfunction	OBU should be designed to detect and log alarms. Some of these shall be displayed on the user interface. Logged alarms shall be transmitted to enforcement RSE/Mobile Enforcement equipment and to EETS provider's central system (via RSE/DSRC or GSM).				OBU should be designed with such internal checks that any malfunction is displayed on the user interface.
ROUTES / COURSES INCONSISTENCIES					
Passing an exit toll without information about the entrance	All lanes – including manual lanes - should be equipped with transceivers for OBU communication and automated license plate recognition, where combined input is stored in back-office. This data can be matched at exit points as needed.				
Inconsistent time/ and place sequences	Combination of some mobile enforcement in addition to enforcement at fixed				

SITUATION	TYPE OF INSTALLED EFC TECHNOLOGY				
	DSRC MONO-LANE	DSRC MULTI-LANE	GNSS-CN	BOOKING SYSTEM	TACHOGRAPH
	installations can clarify whether these cases are some form of equipment malfunction or deliberate manipulation.				
Vehicle registered in the booking system but whose payment is insufficient				Adequate number of automated license plate recognition installations can clarify the length of traveled distance the driver is liable paying for.	
Vehicle registered in the booking system but whose route is different from the one declared				Adequate number of automated license plate recognition installations can clarify the length of traveled distance the driver is liable paying for. A fine may also be applicable.	
ATTEMPT TO INHIBIT THE PAYMENT/ENFORCEMENT					
License plate hidden / illegible (attempt to inhibit the payment or enforcement)	Automated license plate recognition system can alert mobile enforcement vehicles in such cases to enforce vehicles with hidden license plate.				
"Little train" / "Piggybacking" / "Tailgating" (attempt of inhibition of payment)	Equipment producing accurate vehicle edge detection (for example laser scanner) can be				

SITUATION	TYPE OF INSTALLED EFC TECHNOLOGY				
	DSRC MONO-LANE	DSRC MULTI-LANE	GNSS-CN	BOOKING SYSTEM	TACHOGRAPH
	installed at all lanes to prevent such situations.				
"Little train" / "Piggybacking" / "Tailgating" (attempt of inhibition of enforcement)	Combination of frontal and rear automated license plate recognition cameras with accurate vehicle edge triggering can solve such situation.		Mobile Enforcement will capture such situations through observation and will flag down vehicle for further action.		Combination of frontal and rear automated license plate recognition cameras with accurate vehicle edge triggering can solve such situation.
Two vehicles side-by-side (attempt of inhibition of payment)	When such situation is physically possible, it can be only resolved if the automated license plate recognition system can simultaneously recognize multiple license plates.				
Speed above permissible one (attempt of inhibition of payment/enforcement)	Such situation has very low probability of occurring for both types of OBU.				Such situation has very low probability of occurring for both types of OBU
OTHERS					
OBU low battery	The OBU should signal low-battery state to the driver early enough.				The OBU should signal low-battery state to the driver early enough.
OBU with no valid contract	Situation should be signaled to the User through the OBU HMI interface and				Situation should be

SITUATION	TYPE OF INSTALLED EFC TECHNOLOGY				
	DSRC MONO-LANE	DSRC MULTI-LANE	GNSS-CN	BOOKING SYSTEM	TACHOGRAPH
	the violator shall be prosecuted through automated license plate recognition data or by mobile enforcement vehicle.				signaled to the User through the OBU HMI interface and the violator shall be prosecuted through automated license plate recognition data or by mobile enforcement vehicle.
OBU software/firmware or data not up to date or invalid	In case OBU has the complete set of enforcement interfaces, it should be designed with on the drive software and data update capability. The large bandwidth enables that enforcement installations force updating of correct data to OBUs.		OBU will signal this state to the driver as a malfunction – since update did not happen in time. Violator shall be prosecuted through automated license plate recognition data or by mobile enforcement vehicle.		OBU will signal this state to the driver as a malfunction – since update did not happen in time. Violator shall be prosecuted through automated license plate recognition data or by mobile enforcement vehicle.
OBU identified in the *black list*	Violator shall be prosecuted through collected OBU data or by mobile enforcement vehicle.		State shall be signaled to vehicle operator by OBU HME and violator shall be prosecuted through automated license plate recognition data or by mobile enforcement vehicle.		Violator shall be prosecuted through collected OBU data or by mobile enforcement vehicle.

SITUATION	TYPE OF INSTALLED EFC TECHNOLOGY				
	DSRC MONO-LANE	DSRC MULTI-LANE	GNSS-CN	BOOKING SYSTEM	TACHOGRAPH
OBU with *video flag* on	Back-office retains and processes license plate data of the passing vehicle with OBU wanted flag.				
OBU with *tampering flag* on	Violator shall be prosecuted through collected OBU data or by mobile enforcement vehicle.				Violator shall be prosecuted through collected OBU data or by mobile enforcement vehicle.
OBU not supporting the RSE Enforcement Protocols	Enforcement system shall cope with the drawbacks of OBU-less enforcement procedures. Such situation would currently only happen in the low-cost OBU case, as the OBU with complete set of enforcement interfaces supports all currently utilized enforcement communication protocols.				Enforcement system shall cope with the drawbacks of OBU-less enforcement procedures. Such situation would currently only happen in the low-cost OBU case, as the OBU with complete set of enforcement interfaces supports all currently utilized enforcement communication protocols
Faking OBU or OBU Data	Secure Integrity of System concerning Firmware, Software, Data (Configuration Data, Log Files, Geo Data, Tariff Data, other, where applicable) and Communications over all electronic Interfaces by strong cryptography and good security architecture in HW and SW (e.g. use of secure application module chip cards).				Secure Integrity of System concerning Firmware, Software, Data (Configuration Data, Log Files, Geo

SITUATION	TYPE OF INSTALLED EFC TECHNOLOGY				
	DSRC MONO-LANE	DSRC MULTI-LANE	GNSS-CN	BOOKING SYSTEM	TACHOGRAPH
					Data, Tariff Data, other, where applicable) and Communications over all electronic Interfaces by strong cryptography and good security architecture in HW and SW (e.g. use of secure application module chip cards).
EETS System Intrusion and Data Privacy	Secure Integrity of System concerning Firmware, Software, Data (Configuration Data, Log Files, Geo Data, Tariff Data, other, where applicable) and all Communications over all electronic Interfaces by strong cryptography and good security architecture in HW and SW (e.g. use of secure application module chip cards). Define and implement well defined Role Model and cryptographic key infrastructure that allows correct Authentication, Authorization and Accountability for every action of every EETS participant.				Secure Integrity of System concerning Firmware, Software, Data (Configuration Data, Log Files, Geo Data, Tariff Data, other, where applicable) and all Communications over all electronic Interfaces by strong cryptography and good security architecture in HW and SW (e.g. use of secure application module chip cards). Define and implement well defined Role Model and cryptographic key

SITUATION	TYPE OF INSTALLED EFC TECHNOLOGY				
	DSRC MONO-LANE	DSRC MULTI-LANE	GNSS-CN	BOOKING SYSTEM	TACHOGRAPH
					infrastructure that allows correct Authentication, Authorization and Accountability for every action of every EETS participant.
EETS cryptographic key breach	Make sure, that role model and key infrastructure allows revocation and replacement of any key that became insecure. Plan for regular key replacements in a well defined key life cycle. Use one-time session keys for every single communication derived from master keys for individual communications to protect against analysis of master keys. Store and use keys only in secure, closed environments (e.g. secure application module chip cards).				Make sure, that role model and key infrastructure allows revocation and replacement of any key that became unsecure. Plan for regular key replacements in a well defined key life cycle. Use one-time session keys for every single communication derived from master keys for individual communications to protect against analysis of master keys. Store and use keys only in secure, closed environments (e.g. secure application module chip cards).

5 RECOMMENDATIONS ON ENFORCEMENT

After identifying and analyzing in detail all the possible situations of violation and the different technologies that could be used in order to respond to identified enforcement needs, this chapter includes a set of recommendations that should be considered by the state members regarding enforcement in an EETS environment.

These recommendations are organized in four main groups:

- **Technical recommendations**

  These recommendations are essentially related with the equipment and applications that should be used in the toll gantries or check points and with the information systems implemented on the EFC systems back-office.

- **Legal and regulation recommendations**

  This set of recommendations is focused on the legal issues that the state members should attend in order to implement an EFC System at a European level.

  Note: in no way did the EG10 members intent to overlap those recommendations made by Expert Group 3 (EG3). They have the unique intention of being complementary.

- **Internal and inter-partner recommendations**

  There are also some issues to consider when defining a European EFC system that are related with the procedures to be implemented in an interoperable environment (for example, the procedures of communication between TSP's from different countries).

- **User Contract recommendations**

  The last group of recommendations refers the required issues to consider when defining the EETS contract between the EETS Providers and the Users.

The recommendations that result from the work and study made by the EG10 members are:

RECOM. N.º	RECOMMENDATION	RELEVANCE	JUSTIFICATION
TECHNICAL RECOMMENDATIONS			
1	For lane-constrained systems the installation of high-precision and fast response RSE is critical and should be encouraged in order to make it possible to detect violations as “tailgating” or “piggybacking”. This equipment should be installed even if the EFC system includes lifting bars.	High	“Tailgating” or “Piggybacking” is a fraud mechanism possible between two or more adjacent vehicles in a DSRC free flow environment or even in conventional toll plazas with lifting bars. It may take place when two adjacent vehicles, both equipped with OBU’s, specially trucks, follow each other too close and the second vehicle falls in the communication shadow zone of the first one. It may also be used to prevent a lifting bar to close between two adjacent vehicles, where normally the second car is not equipped with an OBU. In free flow and/or multilane environment between OBU equipped light vehicles this is very rare since the communication time between RSE and OBU is very short compared to exposure time of the OBU to the electromagnetic field of the RSE antenna. With time some users may get acquainted with this fraud mechanism and may try to use it on a regular basis. One of the main requirements to address when setting-up the cross-border enforcement system (which includes data exchange about national and non-nation violators) is its credibility. The improvements identified in this recommendation increase system credibility.
2	The use of the EETS by European citizens is not intended to be	High	With no alternative the number of violations will tend to increase.

	mandatory. So, an alternative charging method like manual lanes, automatic lanes (cash, debit/credit card) or a booking system is still needed on tolled roads to be used by the non-EETS-equipped users.		
3	Whenever possible, manual lanes should also be equipped with DSRC beacons.	High	This recommendation, more than attempting to establish a good practice, intends to: ▪ Reduce the initial difficulties of the users in detecting the EETS dedicated lanes; ▪ Avoid loss of route courses when a vehicle passes an electronic dedicated lane on the way-in and a manual lane on the way-out (or vice-versa); ▪ Avoid the overload of back office processes circulating among the EETS enforcement actors.
4	Toll barriers and fixed check-points should be equipped with: ▪ IR camera(s) that capture front-side pictures of the vehicle; ▪ IR camera(s) that capture rear-side pictures of the vehicle; ▪ Camera(s) to capture a panoramic image of the vehicle. *(note: please see other considerations in the Legal / Regulation section)*	High	The use of infrared technology allows a higher level of accuracy when using OCR systems and avoids legal and data protection restrictions, since it is not possible to recognise the driver's face. Enforcement systems using the combination of more than one camera are already implemented with good results (in Portugal and Germany, for instance).
5	Digital photographs shall be secured by a qualified digital signature.	High	To avoid photograph manipulations by interested parties
6	If LPR systems are used for license plate number recognition a minimum level of accuracy for such systems shall be defined in order to minimize manual processing. Nevertheless, visual	High	This recommendation intends to increase the credibility of the EETS enforcement system and to minimize manual verification of the recognized license plate numbers. Identifications with a confidence

	inspection of pictures is recommended for recognitions performed with a level of confidence below a threshold to be defined. It may happen that in case of prosecution, legal authorities require manual processing of pictures.		below a certain limit shall be subject to visual inspection in order not to jeopardize the reliability of the EETS enforcement system
7	On-Board Units for EETS service may support combinations of wireless enforcement interfaces in use today - CEN Microwave, ISO InfraRed, and Telepass MicroWave. In its simplest and lowest cost configuration it shall support CEN Microwave based wireless enforcement interface. In its more complete, and most probably, more expensive configuration, it should support CEN Microwave, ISO InfraRed, and Telepass MicroWave.	High	This recommendation is crucial for enabling mobile enforcement for EETS service and for optimizing cost to the User based on expression of service usage (geographical). The recommendation intends to: • Enable toll operators to use their existing infrastructure for EETS enforcement; • Enable mobile enforcement of EETS service, by requiring the presence of a communication medium suitable for mobile enforcement; • Provide possibility of slow migration to future proof enforcement communication, while not causing any abrupt change in current OBU cost sensitive business models; • Enable future integration of such applications into EETS On-Board Unit, which require high data-rate enforcement communication or mobile enforcement (for example Digital Tachograph enforcement).
8	An enforcement transaction structure shall be defined encapsulating information regarding to OBU status (enclosure violation, OBU	High	Besides the normal transaction, an enforcement transaction may be necessary in order to inform the EETS Players on the status of the

	hacked, power feeding status, alarms of relevant electronic modules, etc). The proposed definition may be undertaken by CESARE III or a future EG responsible for the integration of the different contributions to the enforcement issue.		OBU (for DSRC-MW and DSRC-IR-enforcement links).
9	The OBU shall be fixed to the vehicle (even for self-installation schemes), in order to decrease the number of irregular / violation situations since the driver does not fix the OBU at the appropriate place to be read/written by the RSE. Questions of maintenance and size of the OBU are relevant to this subject.	Medium	This recommendation intends to minimize the occurrence of situations of no OBU inside vehicles using EFC lanes (or at least not in a position to allow it to be detected) and, in particular, the use of the same OBU by vehicles of different tariff class.
10	The OBU should be equipped with visual and/or audio signals (lights or sounds) warning the driver when malfunctions arise. The user needs unique information about the status of the OBU to fulfil his obligations.	High	The implementation of this mechanism intends to inform the user as early as possible if his OBU is not working properly and that he is aware of using the EETS-service under anomalous conditions.
11	The OBU should be equipped with visual and/or audio signals (lights or sounds) warning the driver when the battery is low. The RSE should also be able to read this information and to display a warning to the user, when passing a *check point*. The warning trigger level shall take into account that the OBU can still perform at least in normal transactions before being unavailable. The OBU owner notification process shall be defined (by sms, phone call, letter, …) in order to assure the regularization of the situation.	High	The implementation of these warning mechanisms intends to inform the user about an anomalous situation, giving him the chance to regularize it, and to prevent some failed EFC transactions.
12	In the near future it is advisable to personalize the OBU with the license plate number.	High	This information will be useful in solving situations of discrepancy of declared and measured parameters class. Especially in multi lane

			scenarios the knowledge about the correlation between vehicle and transaction record is crucial.
13	Every OBU ought to have a tampering device that could be read by the RSE in order to detect the occurrence of tampering: ▪ The removal of the OBU from the car window; ▪ The violation of the OBU enclosure. ▪ The attack on a communication interface ▪ The detection of incorrect SW/Data	Medium	The relevance of the implementation of this recommendation is higher when considering the second type of tampering, in order to enable the RSE to detect the user's attempt to modify the hardware or software of the device.
14	EETS enforcement equipment should comply with well defined European standards for Tolling Equipment especially in terms of sensitivity, accuracy and data protection requirements. This is required in order to allow implementation of every charging scheme on every OBU and would help make violation evidence equally acceptable regardless of the country where the offence occured.	High	To make it easier for national enforcement authorities to accept evidence of toll violations coming from other European countries, which are based on equipment out of their jurisdiction and inspection possibilities.
15	It is advisable to ask CEN TC278 to advance towards the definition of a common technical framework that comprises all critical features of EETS charging and enforcement equipment. Procedures for compliance with such framework could also be developed in connection with the European interoperability certification process.	High	The rational is the same as above
16	Efforts should be put in order to finalize necessary standards on Electronic Vehicle identification (EVI).	High	EVI will allow to overcome inherent LPR drawbacks such as unreadable license plates, occlusion, variations in fonts/characters, etc
17	The following minimum requirements should apply to evidence of violations taken from the Road Side: - picture resolution 704x576 pixels - bits per pixel : 8 - 24	High	Gives a common basis for evidence for enforcement

	- file formats : BMP, JPEG, TIF - pictures shall include : data, time, toll location, tariff class measured/declared, LPR outcome and confidence level - digitally signed		
18	Protect the Integrity of the EETS System – concerning Firmware, Software, Data (Configuration Data, Log Files, Geo Data, Tariff Data, other, where applicable) and all Communications over all electronic Interfaces by robust cryptography and good security architecture in HW and SW (e.g. use of secure application module chip cards).	High	The ability of all actors and participants of EETS to trust in the System is absolutely **vital** for acceptance of both the system and the service as well as all Data and evidence produced
19	Define and implement well defined cryptographic key infrastructure that allows correct Authentication, Authorization and Accountability for every action of every EETS participant according to role model. Ensure that changes of participants and roles can be handled adequately.	High	All Actions, Data and Communication must be secured and protected and traceable to its requestor and / or originator in such a way, that all actors can trust each other on a technical basis according to legal and contractual regulations. Trust between all system components and actors is **vital** for acceptance of the System and Service.
20	Make sure, that role model and key infrastructure allows revocation and replacement of any key that became insecure. Plan for regular key replacements in a well-defined key life cycle.	High	It must be possible to handle such situations so that System Integrity and thus trust in System and Service and between actors can be maintained.
21	Use one-time session keys for every single communication derived from master keys for individual communications to protect against analysis of master keys.	Medium	This makes attacks on the cryptography of the system more difficult (esp for data transmitted over channels that can be overheard by third parties, e.g. wireless) and reduces cryptography processing load on both side of the channel
22	Store and use keys only in secure, closed environments (e.g. secure application module chip cards).	High	This is required to protect the cryptographic keys and thus System Integrity and trust in EETS system and service as well as between actors.

23	Whenever possible install technical means to inform driver on enforcement outcome while still in the charging area or at least still in the tolling network (enhanced OBU HMI such as audio-visual capabilities, touch screens, pictograms displays, etc and the use of SMS). If achievable, EETS should also define obligations of the user in such occasions.	High	Avoid costly and lengthy prosecution processes that follow a violation, specially in cross border enforcement
LEGAL AND REGULATION RECOMMENDATIONS			
24	The use of pictures for violation evidence should consider the following issues (with relevance to the national legal framework): ▪ The possibility to capture images from the front-end, rear-end and side of the vehicle in order to read the licence plate number and to identify the vehicle; ▪ The possibility to record and archive panoramic images of vehicles in situation of violation (and not only those which capture exclusively the area of the licence plate); ▪ The need to archive all images captured or only those related with the irregular / violation situations; ▪ The maximum period of time allowed to keep images captured (considering also the need for data exchange among different countries); ▪ The certification of the images and the attached data regarding the reliability of the image, the recognized license plate number, the time and place of the violation, etc.	High	These issues should be discussed and decisions have to be made since images are an important means of violation evidence but there are still countries in which legal and privacy policies don't allow the use of this kind of evidence. Although highly dependent on national legislation, the definition of the EETS could be a driver for national legislation revision.
25	Since the future EETS will involve several entities from different countries, a central and neutral agency with regulatory and certification authorities to address issues related to legal procedures,	High	An existing independent and neutral entity will influence and orient all EETS actors, helping to define rules and methods, contributing to the harmony of the system.

	regularization processes and relationship between EETS actors should be set-up.		
26	Equipment (like loops, pressure sensors, cameras and others) certification procedures and means shall be defined, which should at least cover the following capabilities: ▪ Sensitivity; ▪ Accuracy; ▪ Synchronicity; ▪ Integrity.	High	It is very important that all equipment should be reliably certified, in order that all EETS players have confidence on the measured parameters and the accuracy of the produced violation evidence.
27	TSP's/EFCO's agents should have the legal authority to stop vehicles while still in tolled network in order to investigate any possible violation and, if necessary, to initiate the toll/fee recovery procedures. This task may also be performed by an executive authority with police status based on evidence from the TSP/EFCO. As already stated by the EG3, this kind of actions should respect the principle of non-discrimination among people from different member-states. Therefore, vehicles should not be stopped based on nationality criteria.	High	Ensures that no-one can escape enforcement measures or evade payment of charges due
28	Legalize mobile enforcement by TSP's/EFCO's (complement to fixed and portable enforcement)	High	Necessary (but not sufficient) in order to remove lifting bars in DSRC single lane systems but also relevant for GNSS/CN systems.
29	National administrations shall be encouraged to accept the responsibility for inspection and verification of the conformance of	High	Since enforcement will become an essential part of the EETS, it seems most appropriate that national road authorities can cooperate within the EU in this matter, having an explicit mandate to act this

	any EETS enforcement equipment installed in their respective countries, in close cooperation and under supervision of the EETS Management Agency		way. For the trust between all EETS participants including possibly executive/judicative authorities in another nation, certification of both technology and processes against the common set of EETS specs is required)
30	Use of EUCARIS network which provides information about drivers' license and/or vehicle information directly or indirectly through Authorites.	High	Although outside the scope of the Directive 2004/52, it may a way to address the problem raised by non-EETS vehicles/drivers.
INTERNAL AND INTER-PARTNER PROCEDURES			
31	The reliability of the EETS is dependent on the fact that all accepted EETS actors comply with a basic set of rules. The acceptance minimum requirements shall be part of a MoU, certification and accreditation criteria of the EETS Management Agency..	High	This MoU provides a common point of understanding among all EETS players and increases the credibility of EETS.
32	The means of contact and data exchange between the EETS actors is a critical issue when considering a system that will involve different countries. Therefore, the use of a dedicated secure network is recommended that may enable the communication among these entities. This network must include well-defined processes, information systems, applications and document templates so that the sharing of information could be done effectively.	High	A common and reliable network for the resolution of cross-border violations will be fundamental in the EETS environment. The running costs of such network is a relevant issue. Decision between private or public network shall be taken into account cost and security issues.
33	To secure Authentication, Authorization and Accountability between all EETS actors, a well defined Role Model for each entity and each acting role should be established and cast into a common cryptographic key infrastructure that allows to adjust to changes in	High	A common role model and key infrastructure between all actors, preferably overseen by an EETS Interoperability Management will ensure EETS integrity with respect to all SW, Data and Communications and will allow to trace everything to the correct

	Roles, new and leaving entities as well as keys that became insecure. This should include also all relevant public authorities.		originator, including correct authorization. This will allow all actors the required trust between them and to manage all open issues on a contractual and legal basis.
34	Security of systems and their components (e.g. OBU, RSE, communications) as well as processes of all EETS participants (e.g. CIs, TSPs, EFCOs, Public Enforcement Agencies,…) should be part of the EETS certification.	High	This will allow all actors the required trust in the full EETS system and its components, the EETS service and between the actors, even if they do not have full control over all parts of the overall system and all parts of the overall service and processes.
35	In a context of interoperability, the recovery process is one of the most critical issues. In this scope, it is essential to define who the actors in this process will be and clearly identify their roles (mainly when dealing with non-national citizens). This definition should be based on one of the following strategies: ▪ Scenario 1 – With Revenue Assurance The CI pays to the TSP/EFCO the amount in debt (the CI has the responsibility for the toll amount in debt and the user has the responsibility for the eventual penalty resulting from the violation) and then solves the situation with his client; ▪ Scenario 2 – With no Revenue Assurance If under the commercial contract between the CI and the TSP the revenue assurance is not foreseen, and if there is no any legal restriction in the country of the violator, the TSP/EFCO of the country where the violation took place should have the competence to solve the problem directly with the non-national citizen. In any case the CI shall have a Service Level	High	Setting up well-defined procedures is one of the key factors for the implementation of the EETS system.

	Agreement with the TSP specifying all administrative actions to undertake in order to accomplish the recovery of the debt. The choice between these possibilities should be made taking into account commercial and legal issues and the effectiveness of the recovery process. The issue shall be addressed by EG7 and CESARE III.		
36	If a violation is made by a foreign EETS user (that is not identified in the "black-list"), and even if it is established that the CI is responsible for values in debt, eventual penalties and/or fines are not the responsibility of the CI. These shall be supported directly by the User unless otherwise agreed between the CI and the TSP's/EFCO's..The CI must deliver User details to the TSP so that he may recover the values relative to penalties and/or fines.	High	This has a large impact on the commercial relationship and risk sharing between CI and user
37	All CIs must create and maintain legal databases that store personal data related to all EETS Users. These databases also aim at the identification (and further notification) of any adherent in case of violations/irregularities related to him or his contract. Access to the data stored in these databases must be restricted to the CI with whom the User signed the EETS contract.. TSPs/EFCOs should have a means to at least find out if any participating CI has a contract (valid or invalid) for a certain vehicle based on a vehicle's LPN. Under specific circumstances, where the foreign TSP/EFCO presents evidence of violation, the CI may supply the contacts of its client so that he may be notified by the affected TSP/EFCO. The	High	These databases facilitate the process of regularization of anomalous situations, being in this way, a good-practice that should be adopted by all CIs. CI's contracts with users shall explicit the formal consent of the user to this practice..

	possible disclosure of such information to foreign TSP's/EFCO's must be clearly mentioned in the EETS contract with the User. The TSP/EFCO may not constitute a database storing the data supplied by CIs.		
38	In countries in which there is more then one CI, it is advisable to create a unique database of national EETS Users so that it can be easier to retrieve data about an unknown user could be easier. It may happen that a nation list of adherents includes vehicles of a foreign nationality since a CI may issue EETS contracts to foreign users. The national list will in fact be a list of all EETS users with contract with national CI´s. If this solution is adopted, the privacy of these data should be the responsibility of the National Registry Issuer	High	Considering cross-border enforcement, it is important that the process to identify and contact non-national violators be made as fast as possible.
39	The CI should create and maintain "black lists" containing information about users whose contracts are irregular. The rules for including these users in the "black-lists" should be discussed and approved by the EETS actors (or only by the Issuer if each one of them assumes the responsibility of the fee/toll in debt) and must take into account the following issues: ▪ Irregular situations related with the bank account; ▪ Irregular situations related to the EFC contract (values indebt, invalid contracts); ▪ Malfunctions or Tampering of OBU It is advisable that the unique identification number of the OBU	High	This allows to blacklist users for the whole scope of EETS in a common way

	(PAN) should be integrated into the blacklist along with the LPN instead of the client number (because this number could be related with more than one OBU).		
40	In case of a possible violation or irregular situation, the principle of good faith of the user should always be assumed and his declaration should be accepted as true.	Medium	This represents the principle of “in dubio pro reo”..
41	The TSP/EFCO/CI should create and maintain “grey-lists” with information about users that have propensity to violate or attempt to violate the EETS. The rules for the inclusion of users in these lists should consider EG3 concepts of EFC Violation and EFC Fraud and must be discussed and approved by the member states. If necessary, some national legislation should be adapted in order to implement the approved solution. This kind of databases should work as a pre-enforcement tool, that is, a means to identifying possible violators and possible situations of violation in order to take preventive measures to avoid further violations.	Low (mostly, for local use)	This information has more relevance at a local level, by helping EFC entities to study and collect historical information related to irregularities, attempts to violate or possible frauds.
CONTRACTUAL RECOMMENDATIONS			
42	Situations in which a vehicle is found with no OBU but with a valid contract shall not be considered as a violation. Instead, it must be treated as a “special anomalous situation” and the regularization process must be well defined by the EETS actors.	High	This recommendation aims at guaranteeing a special treatment to the EETS “valid” users.

43	A decision must be made regarding the expired contracts: ▪ Either these contracts are included in the "black-lists" (although increasing strongly the dimension of these databases); ▪ Or the OBU records the expired date (although increasing strongly the need for OBU maintenance).	High	An expired contract is a temporary status of a contract. So, in order to prevent some possible violations, the correct procedure must be decided.
44	The inclusion of the following clauses in all EFC contracts should be considered: ▪ Users' obligation to contact the CI in order to adopt procedures when a low battery warning is displayed. ▪ Prohibiting any tampering with the OBU – be it opening an OBU, shielding/disconnecting any antennae, obscuring DSRC links, tampering with sensors etc. ▪ The duty to install, use and treat the OBU correctly, as specified in the user manual. ▪ To yield HMI instructions correctly. ▪ To have OBU checked (and maybe replaced) at a CI certified Service Point on request. ▪ Prohibition of using the OBU in more than one vehicle (the principle should be one OBU per vehicle), in order to avoid the use of the same OBU by different tariff class vehicles. ▪ Users' obligation to inform the CI when a vehicle's characteristic changes. ▪ Users' obligation to inform the CI when there are updates on their personal data. ▪ Users' obligation of keeping license plates correctly installed (position, dimension, …) and in perfect condition	Medium	The user of an interoperable EFC must have, know and act in accordance to a minimum set of rules, in order to have a reliable EETS accepted by all actors.

	for visual/digital reading. ▪ User's acceptance of the transactional procedure for recovery of toll fees in case of violation or unintended error in the use of the EETS in a foreign country.		

6 APPENDICES

6.1 Glossary of Terms

TERMS	DESCRIPTION
ALPR	Automatic License Plate Recognition
CEN TC 278	The technical committee standardizing backscatter MicroWave based DSRC communication
CI (Contract Issuer)	The organisation which issues the services rights to the customer, administers customer and vehicle data, is responsible to make the OBUs available to the customer, organises payment to the EFC Operators.
E.U.	European Union
EFC	Electronic Fee Collection.
EFCO (Electronic Fee Collection Operator)	The organisation entitled to collect the toll, operating the Electronic Fee Collection infrastructure.
eNFORCE	Concept of European Enforcement network proposed by VERA2. It comprises: 1. a net work of agencies and organisations; 2. a data exchange service to facilitate cross-border enforcement procedures.
EUCARIS (European Car and Driving License Information System)	EUCARIS is a unique system that provides opportunities to countries to share their car and registration information, helping to fight car theft and registration fraud. EUCARIS is developed by and for governmental authorities.
Free Flow	Charing system which enables the traffic to pass freely without stopping, whether channelled into single lanes or under normal traffic conditions
HGV	Heavy-Goods Vehicle.
ISO TC 204	The technical committee standardizing several complementary long range and medium range communication technologies within the ISO 'CALM' programme, including the InfraRed, which is referred to in this document
LP	License Plate
Mono-lane	Charging system which channels traffic in one lane. Charging and enforcement of each may be dedicated (to EFC or lorries for example).
MoU	Memorandum of Understanding
Multi-lane	Charging system, which does not channel traffic. Charging and enforcement are undertaken across all lanes of the road.

OBU	On-Board Unit used for tolling.
OBU Issuer	Organisation which acquires and issues qualified OBUs.
PAN	Private Account Number
RSE	Road Side Equipment necessary to the charging and enforcement system.
Single-lane	Same as Mono-lane
TSP (Transport Service Provider)	The organisation which provides a transport service to the user (i.e. the road operator).
Toll plaza	Area dedicated to fee collection at entrance or exit, or in the middle of motorways sections.
VCE	Vehicle Classification Equipment
VERA2	European project ended in 2004, which has addressed the practicalities of cross-border enforcement in Europe.

6.2 Current EFC and Enforcement Systems Analysis

6.2.1 INTRODUCTION

In the scope of the current report, a questionnaire was previously elaborated aimed at the TSPs of the different European countries involved in the CESARE Project initiative. This questionnaire was intended to obtain a characterization of the current EFC and enforcement systems of the enquired entities, as well as to obtain a set of tendencies and requirements that may be appropriate for the functional and technological definitions that will be established throughout this report.

Twelve of the enquired TSPs answered the questionnaire. In the next sections are presented the questions included on the questionnaire and the responses obtained.

6.2.2 QUESTIONNAIRE

The template delivered to the TSP is included in the following pages.

DIRECTIVE 2004/52/CE

on Interoperability of Electronic Fee Collection Systems in Europe

Expert Group 10: Technologies and specification for enforcement

Templates for Interviews

Enforcement and violations of toll payments

Questionnaire

This questionnaire is designed to support the action of the Expert Group 10 as part of an evaluation of current frame and needs of enforcement in case of violations/frauds of toll payments. Questions apply to all road organizations involved in the toll payments process, either as a motorway concessionaire or as state authority managing roads or other relevant body.

Purpose of this interview is to have a first overview of the present situation on toll payments in some EU countries, focusing on the adopted solutions and procedures taken as enforcement for contesting violations and to evaluate the related developments forecast for the future.

Please take note that answers are not considered as an official position or official data, but as an expert's opinion. Answers will be used anonymously.

Thanks for your time and your attention.

Name: Surname:

Company: Subsidiary from Position:

Toll environment

How many points of toll collections/points of enforcement are present in your network (km´s of tolled roads, # tolling barriers and lanes, in case of DSRC based systems, enforcement check points)? Which is the overall number of gantries in your country?

Answer

Toll collection is performed by:

Percentage

Toll collection is performed by:	Percentage
▪ Manually (cash and cards)	
▪ Automatic with cash	
▪ Automatic only cards	

Have you plans for adopting a new technology for toll collection (DSRC, satellite-based or other) ? If Yes, please specify, defining also the time frame in which the adoption is supposed to happen.

Answer

Toll violations

Which is the most frequent type of a toll violation related to the EFC system?

Answers:

1.

2.

3.

4.

5.

Average number of monthly violations and average number of violations related to EFC (express in absolute terms and in relative terms taking into account the average number of transactions):

Answer

Toll enforcement

Do you use lifting bars in your EFC lanes ?

Answer

How is the violation detected?

1. **Manually (operator at gate)**
2. **Automatically (through enforcement equipment)**

3. Both
Answer: 1. 2. 3.
What technologies are you using in the detection and recording of violations (video, photographs, OCR/LPR, vehicle classification equipment, etc)?
Answer
Could you describe the procedure that your organization set-up to recover the toll when a violation occurs?
Answer
Is there a specific legal framework for EFC/toll enforcement in your country?
Answer
Which organization/authority is legally entitled to prosecute violators on the road (still en-route) and off the road?
Answer
Which percentage of the violations is related to vehicles with foreign plate on the overall number of violations in your network?
Answer
How do you handle (and how) a violation made by: ▪ **vehicle with license plate of a country of the European Union** ▪ **vehicle with license plate of a country outside the European Union**
Answer
Development of enforcement
Has your organization already developed a plan in order to adopt the European Directive on EFC, taking in account also new possible kinds of violation coming from the Europeanwide opening of the toll system?
Answer
Do you have plans for improving your enforcement? If yes how?
Answer
Do you have plans for the improvement of the cross-border enforcement?
Answer
Which organizations in your country or abroad should be involved in a cross-border violation?
Answer
Which public bodies should be involved in the enforcement procedure?
Answer
If you do not already use it, do you plan to use video capture of license plates in case of violations?
Answer
Is the memorization and processing of the license plate numbers allowed by your legislation?
Answer
Is the evidence of violation (content, format, etc) clearly defined?

Answer
Do privacy restrictions apply to EFC enforcement and to what extent?
Answer
Could you think about future barrier-less EFC in your country (if not already performed)? Which impact could have on your organization this application? Which change in the enforcement procedures?
Answer

Notes: _____

QUESTION n. 1

How many points of toll collections/points of enforcement are present in your network (km´s of tolled roads, # tolling barriers and lanes, in case of DSRC based systems, enforcement check points)? Which is the overall number of gantries in your country?

Country		Concessionaire	
	ITALY		***Autostrada dei Fiori S.p.A.***

ANSWER:

Data related to the year 2004: n. 13 tollgates; 1 terminal barrier, 85 exit lanes.

Data 2004

Toll collection is performed by:	**Percentage**
Manually (cash and cards)	**50,3**
Automatic with cash	**2,4**
Automatic only cards	**13,6**
Bi-modal (EFC + cards)	
Only EFC (DSRC, GNSS…)	**33,7**

Country		Concessionaire	
	ITALY		***Autostrade per l'Italia S.p.A.***

ANSWER:

Network: Km 3.600 (of which Autostrade per l'Italia Km 2.800)

ASPI Toll collection is performed by:	**Percentage**
Manually (cash and cards)	**515 (36%)**
Automatic with cash	**196 (14%)**
Automatic only cards	**213 (15%)**
Bi-modal (EFC + cards)	**160 (11%)**
Only EFC (DSRC, GNSS…)	**292 (21%)**

Country		Concessionaire	
	ITALY		***SATAP S.p.A.***

ANSWER:

4 tolling barriers; 20 points of toll collection; 291 km of tolled roads; 2 enforcement check points; 140 gantries.

Toll collection is performed by:	**Percentage**
Manually (cash and cards)	**34,2**
Automatic with cash	**13,6**
Automatic only cards	**15,0**
Bi-modal (EFC + cards)	**17,8**
Only EFC (DSRC, GNSS…)	**19,4**

Country		Concessionaire	
	SPAIN		***ACESA***

ANSWER:

ACESA motorways AP7, AP2, C32, C33

- 550 Km of toll motorways
- 649 Toll lanes
- 359 Toll lanes equipped with EFC (DSRC)

	Toll collection is performed by:	**Percentage**
Manually (cash and cards)	19%	
Automatic with cash	0%	
Automatic only cards	25%	
Bi-modal (EFC + cards)	40%	
Only EFC (DSRC, GNSS…)	16%	

Country		Concessionaire	
	SPAIN		***CINTRA***

ANSWER:

CINTRA concessions in Spain:

- 515 Km of toll motorways
- 350 Toll lanes
- 105 Toll lanes equipped with EFC (DSRC)

	Toll collection is performed by:	**Percentage**
Manually (cash and cards)	50%	
Automatic with cash	0%	
Automatic only cards	20%	
Bi-modal (EFC + cards)	20%	
Only EFC (DSRC, GNSS…)	10%	

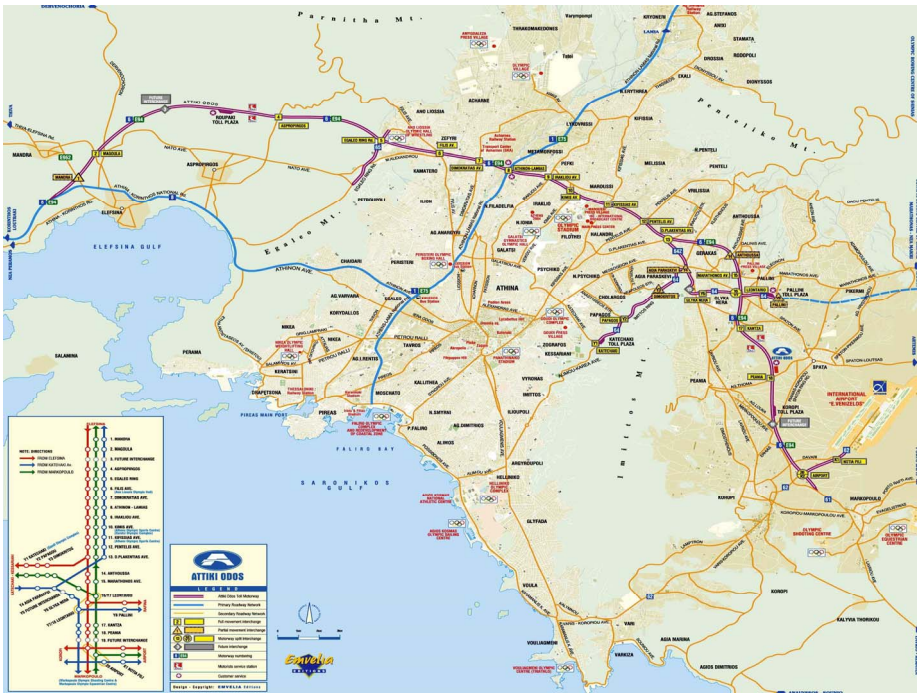
Country		Concessionaire	
	GREECE		***ATTIKES DIADROMES SA***

ANSWER:

In Attiki Odos, which is a 65 km Urban Motorway (2x3 lanes) there are 38 points (Toll Stations) which are located to the entries to the Motorway. The number of lanes per toll station is ranging from 3 lanes to 15 lanes and in total there are 193 toll lanes, all equipped with gates.

The Project has been constructed on a Concession basis and constitutes the largest co-financed road project in Greece and one of the largest in Europe. It was opened to traffic in sections, with the first section opening in March 2001, while the whole project was completed in June 2004. The Annual Average Daily Traffic (AADT) varies, ranging from 40,000 vehicles per day to 120,000 vehicles on the Most heavily trafficked section. Tolls are collected both manually, as well as electronically, based on a 5.8 GHz DSCR system. Te tolling regime is that of an open flat toll system, where the fare varies according to 6 categories from 1.20 Euros for motorcycles to 10.00 Euros for heavy trucks, with passenger cars are paying 2.50 Euros. Since all toll stations are equipped with lifting bars there are no enforcement check points. Also there are no Open Road Tolling Gantries. There were about 84,7 million transactions recorded in 2004 which indicates that the Average number of toll transactions per day is about 231,000. **Today (as of October 31st 2005) there are 125.000 Attiki Odos OBU's (transponders) in circulation, generating in about 86.000 EFC transactions on an average day (more than 1/3 of total traffic), a number that it grows continuously**.

Following is a Project Map and relevant Detailed Project Statistics.



The main characteristics of the Motorway are as follows:

- Total length: (km) 65.2
- Toll Road Interchanges: 24
- Interchanges of other roads: 5
- Toll Stations: 38
- Total Number Toll Lanes: 193
- Motorist Service Stations: 4
- Operation & Maintenance Centre : 1
- Traffic Management Centre: 1
- Customer Service Locations: 9
- Tunnels and Cut & Cover Sections: 56
- Total Length of Tunnels (km): 15.36
- Overpasses: 100
- Underpasses: 25
- Railroad Crossings: 38
- Pedestrian overpasses: 15
- Stream Encroachment Bridges: 21

The Attiki Odos Motorway includes 38 plazas over the 65 kilometer of the motorway. Toll Plazas are organized as follows:

- 4 mainline plazas are located at the entrance extremities of the motorway,
- 34 plazas are located at ramp access of the motorway.

There are five toll collection Sections (which are not the same as the six construction geographic sections).

These sections are based on the Toll Collection System (TCS) structure:

- Section A: Toll Super Plaza is Roupaki
- Section B: Toll Super Plaza is Metamorfosi West
- Section C: Toll Super Plaza is Metamorfosi East
- Section D: Toll Super Plaza is Katechaki
- Section E: Toll Super Plaza is Imittos

The toll categories are:

- Category 1: Motorbykes
- Category 2: Cars, cars with trailers, minibuses and light commercial vehicles
- Category 3: Small and medium HGV's
- Category 4: Large HGV's (4 axles or more)

Two methods of payment are accepted:

- Cash
- Through accounts e-Pass (DSRC electronic tolls)

The toll system is open and flat (toll fare due at the entrance of the motorway whatever the distance to perform).

Toll collection is performed by:	**Percentage**
Manually (cash and cards)	**67 %**
Automatic with cash	
Automatic only cards	
Bi-modal (EFC + cards)	
Only EFC (DSRC, GNSS…)	**33 %**

Country		**Concessionaire**	
	GREECE		***EGNATIA ODOS AE***

ANSWER:

Egnatia Odos is a 680km motorway, whose 65% has been already given to traffic. Tolls are not installed yet; however, a toll plan exists, consisting of the following basic points: i) open toll system, ii) installation of 13 frontal toll stations along the 680km, iii) initial stage: manual toll lanes, plus 1 EFC lane per direction per station, iv) progressively: switch from manual lanes to EFC lanes, v) final target: full EFC system.

Toll collection is performed by:	**Percentage**
Manually (cash and cards)	Not Available
Automatic with cash	Not Available
Automatic only cards	Not Available
Bi-modal (EFC + cards)	Not Available
Only EFC (DSRC, GNSS…)	Not Available

Country		**Concessionaire**	
	GREECE		***TEO SA***

ANSWER:

917Km of tolled roads, 17 toll plazas (10 EFC toll plazas), 112 toll lanes (12 EFC lanes)

Average number of EFC transactions per month: 310.000.

Toll collection is performed by:	**Percentage**
Manually (cash and cards)	**~90%**
Automatic with cash	
Automatic only cards	
Bi-modal (EFC + cards)	

Only EFC (DSRC, GNSS…)	**~10%**

Country		Concessionaire	
	PORTUGAL		***BRISA***

ANSWER:

Toll collection is performed by:	**Percentage**
Manually (cash and cards)	**40%**
Automatic with cash	
Automatic only cards	
Bi-modal (EFC + cards)	
Only EFC (DSRC, GNSS…)	**60% (DSRC)**

Country		Concessionaire	
	GERMANY		***HERRENTUNNEL LÜBECK GMBH***

ANSWER:

The Herrentunnel at the river Trave in Lübeck (Northern Germany) is the second PPP-financed tunnel in Germany where the concessionaire has the right to collect tolls from all users. The tunnel including the toll plaza was opened in August 2005.

The complete tolled road is 2125 m long with a tunnel length of about 860 m.

There is one toll plaza with the same configuration for each direction (2 * 5 single lanes), i.e.

- 1 dedicated EFC (DSRC) lane
- 1 lane with EFC (DSRC)and coin machine
- 1 lane with EFC (DSRC), coin machine and manually
- 2 lanes with EFC (DSRC) and manually

Manually payment includes payment with fleet cards. Credit Cards are not allowed.

Additionally payment with debit cards is possible in each lane without the dedicated EFC lane.

Toll collection is performed by:	**(Percentage) each direction**
Manually (cash and cards)	**2 lanes**
Automatic with cash	**2**
Automatic only cards	**4**
Bi-modal (EFC + cards)	**2**
Only EFC (DSRC, GNSS…)	**1**

Country	Concessionaire
GERMANY	*WARNOWQUERUNG GmbH & Co. KG*

ANSWER:

The Warnowquerung (Crossing of the river Warnow) in Rostock (Northern Germany) is the first PPP-financed tunnel in Germany where the concessionaire has the right to collect tolls from all users. The tunnel including the toll plaza was opened in September 2003.

The tunnel length is about 790 m.

The toll plaza consists of 9 lanes, i.e. 4 lanes per direction plus a bidirectional lane.

- 1 dedicated EFC (DSRC) lane per direction
- 7 lanes with EFC (DSRC), coin machine and debit cards
- 4 lanes with manual payment

Manually payment includes payment with fleet cards and credit cards.

Toll collection is performed by:	**Percentage**
Manually (cash and cards)	**n.a.**
Automatic with cash	**n.a.**
Automatic only cards	**n.a.**
Bi-modal (EFC + cards)	**n.a.**
Only EFC (DSRC, GNSS…)	**n.a.**

Country	Concessionaire
AUSTRIA	*ASFINAG*

ANSWER:

Approx. 2.100 km

100 Stationary Control Equipment (inclusive Stationary Controll Equipment for Stop & Go traffic at jamming zones) 26 Portable Control Equipment

about 800 gantries growing according to the extension of the tolled roads (approx. 2 gantries per 5km)

Toll collection is performed by:

Percentage

Toll collection is performed by:	**Percentage**
Manually (cash and cards)	

Automatic with cash	
Automatic only cards	
Bi-modal (EFC + cards)	
Only EFC (DSRC, GNSS…)	**100%**

Country		**Concessionaire**	
	GERMANY		***Bundesamt f. Güterverkehr*** ***TollCollect GmbH***

ANSWER:

In Germany already an open toll-system without barriers does exist (covering approximately 12.000 km tolled roads).
Users can choose between different ways to log on to the toll-system:
Automatically by using (non mandatory) On Board Unit - OBU (about 480.000 vehicles equipped with OBU) and Manually:
– by using Toll-Terminals (3.580) or
– internet log on system (IEBS)

Three different types of enforcement equipment:

- 300 Stationary gantries
- approximately 300 mobile control-vehicles (able to control everywhere on tolled-roads/independent from a gantry) and
- combination of the instruments mentioned above (control-officers getting information by a gantry)

1. Automatic by OBU – based on GPS and GSM technology (payment can be done by pre paid, fuel card or direct debit)
2. Manually by Toll-Terminal (booking can be done by cash or vehicle card) or via internet log on system (IEBS); booking can be done by pre paid, fuel card or direct debit

TC/BAG
Approximately 88% of toll is collected automatic by OBU. 12% of toll is collected manually by Toll–Terminals or via internet log on system.

QUESTION n. 2

Have you plans for adopting a new technology for toll collection (DSRC, satellite-based or other)? If Yes, please specify, defining also the time frame in which the adoption is supposed to happen?

Country **Concessionaire**

ITALY ***Autostrada dei Fiori S.p.A.***

ANSWER:

No.

Country **Concessionaire**

ITALY ***Autostrade per l'Italia S.p.A.***

ANSWER:

1. No
2. Yes

No: The current Italian system (all vehicles, monolane DSRC microwave 5.8 GHz) is based upon the UNI-10607 norm and it has been operated in Italy since the year 1990. Plans for future developments involve the same DSRC microwave 5.8 GHz technology, but on a multilane configuration and studies are carried out upon the use of satellite, but with specific reference to value added services and not for toll collection (at present time).

Country **Concessionaire**

ITALY ***SATAP S.p.A.***

ANSWER:

1. As concessionaire we have no plan in view of this, but the centralized research & development offices of the group of motorway have been evaluating the possibilities offered by new technologies.

Not on the short terms

Country **Concessionaire**

SPAIN ***ACESA***

ANSWER:

- No. No other than DSRC systems, at least before Directive 2004/52/CE comes into full force.
- Yes
- New plans

Country **Concessionaire**

SPAIN ***CINTRA***

ANSWER:

- No. Only DSRC systems are planned in the short term.
- Yes
- New plans

Country **Concessionaire**

GREECE ***ATTIKES DIADROMES SA***

ANSWER:

Yes. We intend to move to remove toll Plazas and to move to Open Road Tolling (Gantries) based on DSCR. Time frame is totally depending on modifications of the existing legal framework on toll violation enforcement in Greece.

Country **Concessionaire**

GREECE ***EGNATIA ODOS AE***

ANSWER:

Yes. Toll collection will start manually and will switch progressively to EFC, using DSRC technology.

Country **Concessionaire**

GREECE ***TEO SA***

ANSWER:

Yes. We intend to install at least 1 or 2 EFC lanes in all toll plazas (depending on needs, traffic flows, proximity to urban areas, etc.). The other future plan is to remove the lane barriers.

Country **Concessionaire**

PORTUGAL ***BRISA***

ANSWER:

1. No
2. Yes

New plans

Country **Concessionaire**

GERMANY ***HERRENTUNNEL LÜBECK GMBH***

ANSWER:

1. No, because we just started with the operation, so no change of technology is necessary.
2. Yes

New plans

Country **Concessionaire**

GERMANY ***WARNOWQUERUNG GmbH & Co. KG***

ANSWER:

1. No
2. Yes, we think of it because we are not very satisfied with the high failure rate for the DSRC-communication

New plans:

We just have improved the debit card system from magnetic stripe cards to a smart cards.

This system works very well so we think about rising the ratio of these users by marketing campaigns.

Country **Concessionaire**

AUSTRIA ***ASFINAG***

ANSWER:

1. No, the DSRC system works well.
2.

No new plans

Country **Concessionaire**

GERMANY ***Bundesamt f. Güterverkehr***

TollCollect GmbH

ANSWER:

No

QUESTION n. 3

Which is the most frequent type of a toll violation related to the EFC system?

Country	**Concessionaire**
ITALIA	***Autostrada dei Fiori S.p.A.***

ANSWER:

For internal procedures it is not possible to produce such information in the required lapse of time.

Country	**Concessionaire**
ITALY	***Autostrade per l'Italia S.p.A.***

ANSWER:

1. No entry data
2. No dialogue between OBU and RSE
3. False identity (black list)
4. Insolvency (no payment of invoices)
5. Non-equipped vehicle immediately behind a regular equipped vehicle.

Country	**Concessionaire**
ITALY	***SATAP S.p.A.***

ANSWER:

1. Exit by telepass gantry without "telepass equipement" on board.
2. Unsolved invoice.

Country	**Concessionaire**
SPAIN	***ACESA***

ANSWER:

1. Piggybacking (violator car sneaks behind a toll-compliant vehicle passthrough).

Country	**Concessionaire**
SPAIN	***CINTRA***

ANSWER:

- Piggybacking (violator car sneaks behind a toll-compliant vehicle passthrough).
- Fake entry point (violator uses a non-EFC lane when entering a motorway equipped with a closed-loop toll system, and complains at the exit of a malfunction of the EFC system in order to claim a cheaper fare).

Country **Concessionaire**

GREECE ***ATTIKES DIADROMES SA***

ANSWER:

Since all lanes (manual and electronic) are equipped with lifting bars, there is only one type of toll violation for EFC system which is the two vehicles passing together (tailgating) where the first pays and the other one does not pay.

Country **Concessionaire**

GREECE ***EGNATIA ODOS AE***

ANSWER:

Not available.

Country **Concessionaire**

GREECE ***TEO SA***

ANSWER:

All lanes, manual and electronic, are equipped with barriers. Therefore violations are very limited (less than 0.5%), all attributed to tailgating, under very extreme (and dangerous) conditions.

Country **Concessionaire**

PORTUGAL ***BRISA***

ANSWER:

1. Transations with non equipped clients.

Country **Concessionaire**

GERMANY ***HERRENTUNNEL LÜBECK GMBH***

ANSWER:

Due to the special conditions at the Herrentunnel [there is a small island (Herreninsel) with about some hundred habitants with an access point between the toll plaza and the tunnel; The town council of Lübeck claimed a toll free access point for the visitors and residents of this island, so the users of the toll plaza which do not want to drive through the tunnel must not be tolled at the plaza; these users have to claim their

destination at the toll booth and then the cashier opens the barrier without payment] there is a violation possibility by claiming the destination "Herreninsel".

Furthermore the Company has no real experience with violators.

Country ***GERMANY*** **Concessionaire** ***WARNOWQUERUNG GmbH & Co. KG***

ANSWER:

1. Try to follow an EFC user bumper-by-bumper to avoid the payment before closing the barrier in the EFC lane.
2. 2 or more Motor cycles try to pay once and move through the opened barrier
3. Lorry drivers with no money get an invoice and have to pay the toll within a short period, many of them do not pay the toll.

Country ***AUSTRIA*** **Concessionaire** ***ASFINAG***

ANSWER:

1. wrong category
2. no DSRC communication
3. Pre-Pay too low
4.
5.

Country ***GERMANY*** **Concessionaire** ***Bundesamt f. Güterverkehr*** ***TollCollect GmbH***

ANSWER:

No or false activation / parameter setting of the OBU

No or incorrect or invalid (outdated) ticket

QUESTION n. 4

Average number of monthly violations and average number of violations related to EFC (express in absolute terms and in relative terms taking into account the average number of transactions)

Country **Concessionaire**

ITALY ***Autostrada dei Fiori S.p.A.***

ANSWER:

For internal procedures it is not possible to produce such information in the required lapse of time.

Country **Concessionaire**

ITALY ***Autostrade per l'Italia S.p.A.***

ANSWER:

The number of global monthly violations is 220.000; EFC transactions is 30M; 30.000 (which corresponds respectively to 0,1% are the ETC violations.

Country **Concessionaire**

ITALY ***SATAP S.p.A.***

ANSWER:

0,2% in manually gantries; 4% in automatic only cards gantries; 21% in only EFC gantries. 0,11% in absolute terms about the total traffic.

Country **Concessionaire**

SPAIN ***ACESA***

ANSWER:

From January to September 2005:

1) All toll lanes: violations 86.413 out of an overall 180.429.833 transactions. Percentage: 0,05%

2) EFC dedicated and bi-modal lanes: violations 51.259 out of 114.210.241 transactions. Percentage: 0,04%

Country **Concessionaire**

SPAIN ***CINTRA***

ANSWER:

Less than 1%.

Country ***GREECE*** **Concessionaire** ***ATTIKES DIADROMES SA***

ANSWER:

From 6000 to 8000 monthly violations (tailgating) related to about 2,600,000 EFC transactions. (Aprox 0.27 % of EFC transactions). Unfortunately, the existing legal framework makes prosecution of violators worthless and economically unfeasible.

Country ***GREECE*** **Concessionaire** ***EGNATIA ODOS AE***

ANSWER:

Not available.

Country ***GREECE*** **Concessionaire** ***TEO SA***

ANSWER:

Percentage of violations less than 0.5%. Average number of EFC transactions per month: 310.000.

Country ***PORTUGAL*** **Concessionaire** ***BRISA***

ANSWER:

Not answer.

Country ***GERMANY*** **Concessionaire** ***HERRENTUNNEL LÜBECK GMBH***

ANSWER:

No real figures, but very, very low.

Country | **Concessionaire**

GERMANY | ***WARNOWQUERUNG GmbH & Co. KG***

ANSWER:

~ 10 violators per month.

Country | **Concessionaire**

AUSTRIA | ***ASFINAG***

ANSWER:

12.000/month at 50 mio transaction per month

0,024% of violations per total transactions

Country | **Concessionaire**

GERMANY | ***Bundesamt f. Güterverkehr***

TollCollect GmbH

ANSWER:

Less than 2 % of the tollable traffic.

QUESTION n. 5

Do you use lifting bars in your EFC lanes?

Country ***ITALY*** **Concessionaire** ***Autostrada dei Fiori S.p.A.***

ANSWER:
Yes.

Country ***ITALY*** **Concessionaire** ***Autostrade per l'Italia S.p.A.***

ANSWER:
Yes.

Country ***ITALY*** **Concessionaire** ***SATAP S.p.A.***

ANSWER:
Yes.

Country ***SPAIN*** **Concessionaire** ***ACESA***

ANSWER:
Yes.

Country ***SPAIN*** **Concessionaire** ***CINTRA***

ANSWER:
Yes, definitely.

Country ***GREECE*** **Concessionaire** ***ATTIKES DIADROMES SA***

ANSWER:
Yes.

Country **Concessionaire**

GREECE ***EGNATIA ODOS AE***

ANSWER:

1. Yes, toll barriers will be in use – a barrier remains close until the EFC transaction is valid and complete.
2. Target is to move barriers and use video enforcement cameras. However this is not preferable at the moment, due to the vague legal regime - penalties for the violators and administrative rights for the operators have not been defined yet.

Country **Concessionaire**

GREECE ***TEO SA***

ANSWER:

Yes.

Country **Concessionaire**

PORTUGAL ***BRISA***

ANSWER:

No.

Country **Concessionaire**

GERMANY ***HERRENTUNNEL LÜBECK GMBH***

ANSWER:

Yes, in all lanes.

The experience of the first weeks after opening shows that the German users, which are in general not very familiar with tolling, did not expected a barrier in their lane so many accidents and damaging of barriers happened.

Country **Concessionaire**

GERMANY ***WARNOWQUERUNG GmbH & Co. KG***

ANSWER:

Yes, in all lanes.

Country ***AUSTRIA***

Concessionaire ***ASFINAG***

ANSWER:

No.

Country ***GERMANY***

Concessionaire ***Bundesamt f. Güterverkehr***
TollCollect GmbH

ANSWER:

Not answer.

QUESTION n. 6

How is the violation detected?

1. **Manually (operator at gate)**
2. **Automatically (through enforcement equipment)**
3. **Both**

Country **Concessionaire**

ITALY ***Autostrada dei Fiori S.p.A.***

ANSWER:

Not anwer.

Country **Concessionaire**

ITALY ***Autostrade per l'Italia S.p.A.***

ANSWER:

The violation is detected automatically by means of DSRC communication procedures which trigger a video enforcement system in case of tentative fraud; the system is composed by a video camera and an OCR multiple software capable of detecting the vehicle number plate and starting the subsequent processes to address the vehicle's owner.

Country **Concessionaire**

ITALY ***SATAP S.p.A.***

ANSWER:

1.
2.
3. Both

Country **Concessionaire**

SPAIN ***ACESA***

ANSWER:

1.
2.
3. Yes

Country **Concessionaire**

SPAIN ***CINTRA***

ANSWER:

1. No
2. Yes
3. Yes

Country **Concessionaire**

GREECE ***ATTIKES DIADROMES SA***

ANSWER:

ETC violations are automatically detected through the post vehicle classification system.

Country **Concessionaire**

GREECE ***EGNATIA ODOS AE***

ANSWER:

The violation in the EFC lanes will be detected automatically (through enforcement equipment – barriers and video cameras).

Country **Concessionaire**

GREECE ***TEO SA***

ANSWER:

Both by operators at adjacent manual gates and by the Vehicle Enforcement System (Video Cameras and License Plate Recognition system).

Country **Concessionaire**

PORTUGAL ***BRISA***

ANSWER:

Automatically (through enforcement equipment).

Country **Concessionaire**

GERMANY ***HERRENTUNNEL LÜBECK GMBH***

ANSWER:

Manually detection by toll supervisor by checking the video-enforcement system. A picture was made for any user of the Herreninsel. These pictures are checked for tunnel users.

Country **Concessionaire**

GERMANY ***WARNOWQUERUNG GmbH & Co. KG***

ANSWER:

1. Manually by the operator in the toll booth or by the toll supervisor
2. Automatically in the EFC lanes

Country **Concessionaire**

AUSTRIA ***ASFINAG***

ANSWER:

1. only automatically (by Stationary and Portable Control Equipment)

2.

3.

Country **Concessionaire**

GERMANY ***Bundesamt f. Güterverkehr***

TollCollect GmbH

ANSWER:

Automatically using enforcement equipment

1. by gantries

2. by control-officers using DSRC and GSM technology from vehicles floating in traffic

QUESTION n. 7

What technologies are you using in the detection and recording of violations (video, photographs, OCR/LPR, vehicle classification equipment, etc)?

Country **Concessionaire**

ITALY ***Autostrada dei Fiori S.p.A.***

ANSWER:

- Manual lanes: the toll agent is in charge of the detection
- automatic/telepass lanes: detection of the licence plates from the remote by the operator and picture of the licence plates.

Country **Concessionaire**

ITALY ***Autostrade per l'Italia S.p.A.***

ANSWER:

We currently uses cameras triggered by the EFC system and 3 OCR's capable to automatically detect the number plate of vehicle and to automatically start the subsequent enforcement procedure passing thru the detection of the vehicle's owner identity. In case the automatic process cannot start a semi-automatic procedure is started and an operator takes care of the problem.

Country **Concessionaire**

ITALY ***SATAP S.p.A.***

ANSWER:

0,2% by operator at gate; 99,8% by photographs.

Country **Concessionaire**

SPAIN ***ACESA***

ANSWER:

- Image processing (video)
- Vehicle classification equipment

Country **Concessionaire**

SPAIN ***CINTRA***

ANSWER:

- Image processing (picture)
- Vehicle classification equipment

Country **Concessionaire**

GREECE ***ATTIKES DIADROMES SA***

ANSWER:

ETC violations (tailgating) is detected and recorded through the Vehicle Classification Equipment. It is noted that since prosecution of violators is almost impossible, there was no reason to install any other systems (video, photos, LPR etc) to record the License Plate of Violators.

Country **Concessionaire**

GREECE ***EGNATIA ODOS AE***

ANSWER:

1. Vehicle classification will take in the lane entry points.
2. Exit barriers and video cameras will be activated in the lane exit points.

Country **Concessionaire**

GREECE ***TEO SA***

ANSWER:

Video camera, OCR/LPR, Automatic Vehicle Classification.

Country **Concessionaire**

PORTUGAL ***BRISA***

ANSWER:

Vehicle classification equipment+video camaras+OCR/LPR.

Country **Concessionaire**

GERMANY ***HERRENTUNNEL LÜBECK GMBH***

ANSWER:

Video-cameras with pictures

OCR

Country ***GERMANY***

Concessionaire ***WARNOWQUERUNG GmbH & Co. KG***

ANSWER:

Supervision cameras for the whole toll plaza

Web cams in the lane

Country ***AUSTRIA***

Concessionaire ***ASFINAG***

ANSWER:

At the Stationary Control Equipment gantries photographs (video pictures) are taken by video cameras with subsequently processing by OCR and License Plate Recognition software, and vehicle classification equipment (Laser scanners)

Country ***GERMANY***

Concessionaire ***Bundesamt f. Güterverkehr***
TollCollect GmbH

ANSWER:

Use of present technology, which is a combination of GPS (localization) /IR-DSRC (communication with OBU using CEN-DSRC on physical Infrared Carrier) / GSM (Communication with central system for manual Booking).

QUESTION n. 8

Could you describe the procedure that your organization set-up to recover the toll when a violation occurs?

Country	**Concessionaire**
ITALY	***Autostrada dei Fiori S.p.A.***

ANSWER:

As a first approach a formal request of payment is sent to the defaulting user. Attached to the formal request are sent all information to help him in the operation of payment (forms to be filled, information for direct transfer, information for payment through the toll stations). If the payment is not made the company proceeds to a formal warning through judicial official and in case of no further reaction from the user the company proceed to the distraint of the properties of the debtor, should the debtor not to proceed to the payment of the defaulting amount the distraint properties are sold to the auction. If the defaulting amount is important and if the defaulting user is known as habitual defaulting user a complaint to the judge is proposed, in order to have a preventive distress of the vehicle. The complaint is retired only when the defaulting user pays back the defaulting amount. If the user instead doesn't pay, it begins the penal procedure for fraudulent insolvency and/or fraud.

Country	**Concessionaire**
ITALY	***Autostrade per l'Italia S.p.A.***

ANSWER:

Violation monitoring is continue. In every insolvency case a devoted Agency takes care of the enforcement procedure on behalf of Autostrade per l'Italia. In case of repetition of violation or fraud a legal prosecution is started by the Company Legal Unit.

Country	**Concessionaire**
ITALY	***SATAP S.p.A.***

ANSWER:

Users can pay the toll in 60 days. After this time, the company send a formal request for payment. Finally, if the users don't react, the SATAP the action passes to the legal adviser.

Country	**Concessionaire**
SPAIN	***ACESA***

ANSWER:

- Occasional violators are asked, when identified, to comply with tolling on a voluntary basis.
- Regular violators and defrauders are reported to Court for civil prosecution.

Country **Concessionaire**

SPAIN ***CINTRA***

ANSWER:

- Occasional violators are requested to pay due tolls
- Regular violators and defrauders are reported to Court for civil prosecution

Country **Concessionaire**

GREECE ***ATTIKES DIADROMES SA***

ANSWER:

We only know the number of ETC transactions that were violations. (see also next question).

Country **Concessionaire**

GREECE ***EGNATIA ODOS AE***

ANSWER:

Not available. It will be defined when the system is installed.

Country **Concessionaire**

GREECE ***TEO SA***

ANSWER:

In general, EFC enforcement is legally addressed under the same regulations as the manual toll collection. The toll employee that witnessed a violation on a manual lane, or the EFC operator of the Video Enforcement System fills in a specific file with the violation evidence data (e.g. picture, vehicle number, etc.) to the TSP. The TSP sends the first penalty with an invoice to the violator. The fine is 20 times the toll payment. If the violator does not pay the penalty the TSP may increase the penalty up to 50 times the toll payment. If penalty is not payed directly to the TSP, the TSP sends the whole file to the tax authorities allowing them to claim the penalty through the national tax system.

Please note that EFC contracts are currently available only to Greek residents.

Country **Concessionaire**

PORTUGAL ***BRISA***

ANSWER:

We send a letter to the client claiming the toll tariff plus a penalty.

Country **Concessionaire**

GERMANY ***HERRENTUNNEL LÜBECK GMBH***

ANSWER:

Right now the company is in negotiations with the Town Council and the Federal State (Schleswig Holstein) to reach a framework for getting fines of the user.

Country **Concessionaire**

GERMANY ***WARNOWQUERUNG GmbH & Co. KG***

ANSWER:

The owner of the car will get a letter with an invoice for the toll plus an additional fee.

The address of the owner can be reached via a link to the national registration database (KBA Kraftfahrtbundesamt).

The invoicing of the additional fee as an administrative fee is not yet legally defined but we hope the be successful if such cases go to court.

In parallel we start an official administrative offence procedure at the public affairs office.

Country **Concessionaire**

AUSTRIA ***ASFINAG***

ANSWER:

Manual follow-up handling of all violations in order to prevent unjustified enforcement (authenticity of pictures, validation if vehicle is subject of toll, alignment of declared vehicle class to actual vehicle class, quality assurance of all taken decisions by re-examination).

National cars: an amicable settlement offer is sent to car owner (registration is checked at BMI)

International cars: Violation is handed over to mobile officers for prosecution and stored for 3 months.

Country	**Concessionaire**
GERMANY	***Bundesamt f. Güterverkehr***
	TollCollect GmbH

ANSWER:

- identification of facts and car owner
- opening of the proceeding by delivery of a official questionnaire requesting detailed informations regarding the violation
- response by user with detailed specification of the driven route, vehicle in use, total weight, emission category, number of axes
- in case of missing response user is charged for a standard distance of 500 km
- for collection of outstanding subsequent for misdemeanour handing over of the proceeding to the Federal Office for Goods Transport (BAG)
- In case of continuous outstanding response handover to legal proceeding (administrative court)

In a parallel procedure a penalty will be imposed in a fine against the person in charge

Fine procedure has to be enforced by Federal Office (BAG)

In case of appeal juridical decision will be done by criminal court.

QUESTION n. 9

Is there a specific legal framework for EFC/toll enforcement in your country?

Country	**Concessionaire**
ITALY	***Autostrada dei Fiori S.p.A.***

ANSWER:

Yes

Road Code: Art. 176: Behavior during the circulation on the highways and on the principal extra urban roads

…..omissis….

17. Whoever transits without staying in correspondence of the toll stations, creating danger for the circulation, as well as for the individual and collective safety, or performs any action with the purpose to elude at all or partly the payment of the toll, will pay an administrative sanction, except the case in which the fact constitutes a crime.

Country	**Concessionaire**
ITALY	***Autostrade per l'Italia S.p.A.***

ANSWER:

Yes.

Codice della Strada Art. 176: Comportamenti durante la circolazione sulle autostrade e sulle strade extraurbane principali

…omissis…

11. Sulle autostrade per il cui uso sia dovuto il pagamento di un pedaggio, i conducenti, ove previsto e segnalato, devono arrestarsi in corrispondenza delle apposite barriere, eventualmente incolonnandosi secondo le indicazioni date dalle segnalazioni esistenti o dal personale addetto e corrispondere il pedaggio secondo le modalità e le tariffe vigenti.

….

16. Per l'utente di autostrada a pedaggio sprovvisto del titolo di entrata, o che impegni gli impianti di controllo in maniera impropria rispetto al titolo in suo possesso, il pedaggio da corrispondere e' calcolato dalla più lontana stazione di entrata per la classe del suo veicolo. All'utente e' data la facoltà di prova in ordine alla stazione di entrata.

17. Chiunque transita senza fermarsi in corrispondenza delle stazioni, creando pericolo per la circolazione, nonché per la sicurezza individuale e collettiva, ovvero ponga in essere qualsiasi atto al fine di eludere in tutto o in parte il pagamento del pedaggio, e' soggetto, salvo che il fatto costituisca reato.

Free translation:

Road Code: Art. 176: Behaviour during the circulation on the highways and on the principal extra urban roads

…..omissis….

17. Whoever transits without staying in correspondence of the toll stations, creating danger for the

circulation, as well as for the individual and collective safety, or performs any action with the purpose to elude at all or partly the payment of the toll, will pay an administrative sanction, except the case in which the fact constitutes a crime.

Country	**Concessionaire**
ITALY	***SATAP S.p.A.***

ANSWER:

Yes

Road Code: Art. 176: Behavior during the circulation on the highways and on the principal extra urban roads

…..omissis….

17. Whoever transits without staying in correspondence of the toll stations, creating danger for the circulation, as well as for the individual and collective safety, or performs any action with the purpose to elude at all or partly the payment of the toll, will pay an administrative sanction, except the case in which the fact constitutes a crime.

Country	**Concessionaire**
SPAIN	***ACESA***

ANSWER:

Currently the offence is considered as an administrative fault by traffic authorities, but the process to fine the violator still has to be designed in detail before it is operational. Reporting to Court is always possible although of little effectiveness in practical terms.

Country	**Concessionaire**
SPAIN	***CINTRA***

ANSWER:

The current procedure requires going to Court and it is too weak for toll recovery purposes. A new procedure, more effective, is hopefully on its way.

Country **Concessionaire**

GREECE ***ATTIKES DIADROMES SA***

ANSWER:

There is no Law for the EFC/toll enforcement in Greece, although there are legal provisions specifically for the benefit of the Public Operators. Unfortunately, our Agency is a private authority and although we have requested that first, the legal framework existing for the Public Agencies be extended to include also all Private Operators and second the overall framework be modernize to cover electronic toll the Greek State has not passed any laws. Therefore we cannot have any enforcement on toll violators. We can only take the case to Civil Court but only after knowing the ID's of violators. Even if there is a record of the License Plate of the violator, information on the drivers ID is not usally available from the relevant authorities. In addition courts are not ruling against the owner of the vehicle and there is no proof of the driver. This legal framework in Greece is not promoting any technological advances.

Country **Concessionaire**

GREECE ***EGNATIA ODOS AE***

ANSWER:

No there is not. The legal framework is very vague. Penalties for the violators and administrative rights for the operators have not been defined yet.

Country **Concessionaire**

GREECE ***TEO SA***

ANSWER:

In general, EFC enforcement is legally addressed under the same regulations as the manual toll collection (specific national law regarding enforcement on TEO's tolled network). There is nothing specific on EFC toll enforcement.

Country **Concessionaire**

PORTUGAL ***BRISA***

ANSWER:

Yes.

Country **Concessionaire**

GERMANY ***HERRENTUNNEL LÜBECK GMBH***

ANSWER:

No specific legal framework for tolling enforcement available.

Country **Concessionaire**

GERMANY ***WARNOWQUERUNG GmbH & Co. KG***

ANSWER:

No specific legal framework for tolling enforcement in general available.

But for the PPP projects , so called F-models like Herrentunnel and Warnowquerung are some rules defined that the private operator can invoice the violator.

Furthermore this is an official administrative offence.

Country **Concessionaire**

AUSTRIA ***ASFINAG***

ANSWER:

Yes – „Bundesstraßen-Mautgesetz“ (= Toll act) and „Mautordnung“ (=Toll directive).

Country **Concessionaire**

GERMANY ***Bundesamt f. Güterverkehr***

TollCollect GmbH

ANSWER:

Implementation of legal procedures is done according to national law.

QUESTION n. 10

Which organization/authority is legally entitled to prosecute violators on the road (still en-route) and off the road?

Country **Concessionaire**

ITALY ***Autostrada dei Fiori S.p.A.***

ANSWER:

Road Police.

Country **Concessionaire**

ITALY ***Autostrade per l'Italia S.p.A.***

ANSWER:

Road Police.

Country **Concessionaire**

ITALY ***SATAP S.p.A.***

ANSWER:

Road Police.

Country **Concessionaire**

SPAIN ***ACESA***

ANSWER:

Either traffic authorities (at national or regional level) or a civil Court.

Country **Concessionaire**

SPAIN ***CINTRA***

ANSWER:

Either traffic authorities or a civil Court.

Country **Concessionaire**

GREECE ***ATTIKES DIADROMES SA***

ANSWER:

Not paying toll is not a traffic violation. Threfore, even the Traffic Police cannot enforce any toll or even EFC toll violations. The only way is to go to court against violators, (provided the identity of the violator is known) to take the risk of a court hearing, to spend 500 to 1000 times more on legal and court fees than the amount of the toll violation.

Country **Concessionaire**

GREECE ***EGNATIA ODOS AE***

ANSWER:

The Police (National Road Traffic Section).

Country **Concessionaire**

GREECE ***TEO SA***

ANSWER:

The TSP is legally entitled to prosecute the violators on the road, using mobile units that need to flag down the vehicle and perform a manual check. Off-the-road, the procedure has been described above.

Country **Concessionaire**

PORTUGAL ***BRISA***

ANSWER:

The operators (TSP).

Country **Concessionaire**

GERMANY ***HERRENTUNNEL LÜBECK GMBH***

ANSWER:

Police for private citizens

The Bundesamt für Güterverkehr (Federal Office for Goods Transport) is responsible for the enforcement of Heavy Goods vehicles (e.g. for the Lkw-Maut Truck trolling system on motorways)

Country **Concessionaire**

GERMANY ***WARNOWQUERUNG GmbH & Co. KG***

ANSWER:

Police for private citizens.

The Bundesamt für Güterverkehr (Federal Office for Goods Transport) is responsible for the enforcement of Heavy Goods vehicles (e.g. for the Lkw-Maut Truck trolling system on motorways).

Country **Concessionaire**

AUSTRIA ***ASFINAG***

ANSWER:

ASFINAG is entitled as the granted company by a special law act and supported by the ministry of interior.

Country **Concessionaire**

GERMANY ***Bundesamt f. Güterverkehr***

TollCollect GmbH

ANSWER:

Not answer.

QUESTION n. 11

Which percentage of the violations is related to vehicles with foreign plate on the overall number of violations in your network?

Country **Concessionaire**

ITALY ***Autostrada dei Fiori S.p.A.***

ANSWER:

45.000/87457=51,52%

Country **Concessionaire**

ITALY ***Autostrade per l'Italia S.p.A.***

ANSWER:

For the year 2004 the insolvencies that have brought to actions aimed at money recovery have been 2.084.000 of which 470.000 (22%) issued to foreign vehicles.

Country **Concessionaire**

ITALY ***SATAP S.p.A.***

ANSWER:

28.3%

Country **Concessionaire**

SPAIN ***ACESA***

ANSWER:

Unknown.

Country **Concessionaire**

SPAIN ***CINTRA***

ANSWER:

Near to nil (Cintra motorways are not located close to the country borders).

Country **Concessionaire**

GREECE ***ATTIKES DIADROMES SA***

ANSWER:

There is a very small number of EFC violations that can be attributed to foreign plates due to the particularity of the project site (Athens, Greece is disconnected from the major axles of Europe, the project is urban and EFC is restricted to light vehicles.).

Country **Concessionaire**

GREECE ***EGNATIA ODOS AE***

ANSWER:

Not available.

Country **Concessionaire**

GREECE ***TEO SA***

ANSWER:

EFC contracts are currently available only to Greek residents.

Country **Concessionaire**

PORTUGAL ***BRISA***

ANSWER:

Not answer.

Country **Concessionaire**

GERMANY ***HERRENTUNNEL LÜBECK GMBH***

ANSWER:

N.a., but very, very low.

Country	**Concessionaire**
GERMANY	***WARNOWQUERUNG GmbH & Co. KG***

ANSWER:

n.a. for passenger cars

~ 50% for lorries

Country	**Concessionaire**
AUSTRIA	***ASFINAG***

ANSWER:

84%

Country	**Concessionaire**
GERMANY	***Bundesamt f. Güterverkehr*** ***TollCollect GmbH***

ANSWER:

Equivalent to the percentage of violations committed by non-german vehicles

(approximately 40 % of total violations).

QUESTION n. 12

Do you handle (and how) a violation made by: 1. vehicle with license plate of a country of the European Union; 2. vehicle with license plate of a country outside the European Union

Country	**Concessionaire**
ITALY	***Autostrada dei Fiori S.p.A.***

ANSWER:

dispatch of the payment notice when is possible to identify the owner of the vehicle, if the defaulting user is known as habitual defaulting user a complaint to the judge for sequestration is issued.

Country	**Concessionaire**
ITALY	***Autostrade per l'Italia S.p.A.***

ANSWER:

In general, there is no formal procedure to enforce foreign plates (no difference between Eu or non Eu plates), due to lack of cross-border agreements and differences in legal regulations for each country.

1. Only in some cases for repetition in violations by the same plate, tentative actions are made by specific Italian authorized agencies and a payment solicit is sent to the vehicle owner (whenever identified). The cost of each control is very high.
2. No money recovery action is started.

Country	**Concessionaire**
ITALY	***SATAP S.p.A.***

ANSWER:

1. No recover toll procedure in both cases.

Country	**Concessionaire**
SPAIN	***ACESA***

ANSWER:

- It has not been feasible up to now, but it will be certainly a prerequisite when the EETS is approved.
- Idem

Country	**Concessionaire**
SPAIN	***CINTRA***

ANSWER:

No action so far.

Country **Concessionaire**

GREECE ***ATTIKES DIADROMES SA***

ANSWER:

There is no handling of any violations not even within Greece, no matter any other countries due to the inadequacy of the legal system.

Country **Concessionaire**

GREECE ***EGNATIA ODOS AE***

ANSWER:

Not available.

Country **Concessionaire**

GREECE ***TEO SA***

ANSWER:

Vehicles coming from countries outside the EU need to use manual toll lanes.

Country **Concessionaire**

PORTUGAL ***BRISA***

ANSWER:

Not answer.

Country **Concessionaire**

GERMANY ***HERRENTUNNEL LÜBECK GMBH***

ANSWER:

1. n.n.

Country ***GERMANY*** **Concessionaire** ***WARNOWQUERUNG GmbH & Co. KG***

ANSWER:

1. n.a.
2.

Country ***AUSTRIA*** **Concessionaire** ***ASFINAG***

ANSWER:

1. both violations are handled by the same way: The violation is detected by the Stationary or Portable Control Equipment and the data are transmitted to the central station where License Plate recognition and OCR software process the video pictures. The results are manually rechecked. If the license plate is not a national one (see below) the mobile officers are informed about the violation and the direction and location of the violator. The mobile officers are entitled by law to stop the violator and to collect the penalty or if this is refused by the driver, then a security is charged and collected or the truck is mechanically locked.
2. National trucks get an amicable settlement offer, which means to pay the offered compensation claim (110/220€) in due time and due amount otherwise in an administration prosecution a penalty of 400 – 4.000e is sentenced and the violation is registered.
   At the time being it could not be distinguished between car holders of member states or non member states, because no administration support treaty exists between the states for the prosecution of toll violations.

Country ***GERMANY*** **Concessionaire** ***Bundesamt f. Güterverkehr*** ***TollCollect GmbH***

ANSWER:

BAG/BMVBS/TC

All violations by registered users (EU as well as non-EU) handled by TC. All violations by non registered users handled by BAG. TC procedures see above.

QUESTION n. 13

Has your organization already developed a plan in order to adopt the European Directive on EFC, taking in account also new possible kinds of violation coming from the European wide opening of the toll system?

Country	**Concessionaire**
ITALY	***Autostrada dei Fiori S.p.A.***

ANSWER:

No.

Country	**Concessionaire**
ITALY	***Autostrade per l'Italia S.p.A.***

ANSWER:

A study has been made in order to possibly remove the obstacles, practical on a sample of repetitive foreign users, on the best actions to start in order to recover money from foreign users and on the current foreign legal legislation about the issues. A good result has been obtained by a sample of about 1500 cases due to 250 German clients with a limited subsequent action of 1 solicit in German language.

The sample has stressed a good result for positive resolutions on one hand (about 37%) and on the other some results conditioned by:

- the research of new methods and instruments to identify the plate nationality, because today this is possible only displaying each and every plate photo;
- the presence of an interface structure in the user's language;
- the activation of a service website destined to EU users/debtors in order to give information beyond what it is written in English on the motorway insolvency ticket receipt;
- the possibility of a convenient on-line payment by means of credit card;
- by the opening of bank accounts in the foreign countries interested by the action;

The study of each country legislation has confirmed the great difficulties to have the vehicle's owner identity, even though in some cases a possibility is given by a possible new EU Directive on the matter of The Code of Road violation (a mechanism based upon the cooperation between each country Police).

The Italian Concessionaires working both in the EC expert groups and in European project with the aim of defining the technical and procedural aspects of the EFC Directive are actively working as well in order to prepare for its application. The problem of cross border enforcement is not easy to solve due also to different applications of the privacy laws in the member states and in some cases it is faced (but not solved) with the help of foreign agencies or with tentative direct address to the foreign violator. The solution will probably pass through the creation of national agencies capable to interface each other making use of local data base of vehicle number plates, should this be allowed by an EC regulation.

Country **Concessionaire**

ITALY ***SATAP S.p.A.***

ANSWER:

I don't know.

Country **Concessionaire**

SPAIN ***ACESA***

ANSWER:

Plans will be developed in accordance with the EETS definition process.

Country **Concessionaire**

SPAIN ***CINTRA***

ANSWER:

Cintra's staff is thinking about this issue, and will act in accordance with the Directive process.

Country **Concessionaire**

GREECE ***ATTIKES DIADROMES SA***

ANSWER:

Unless the Greek legal system complies in full with the European Directives, no measures for adopting the EFC Directive can be taken.

Country **Concessionaire**

GREECE ***EGNATIA ODOS AE***

ANSWER:

Egnatia Odos AE is a fully European funded project and implementation of the EC Directives is compulsory, in order funding is secured.

Country **Concessionaire**

GREECE ***TEO SA***

ANSWER:

TEO SA is considering the road-map towards the adoption of the European Directive on EFC. TEO SA actually adopted the PISTA specification in all new EFC infrastructure from year 2004, covering all 5 vehicle classes in its network (from regular passenger cars to Heavy Good Vehicles).

Country **Concessionaire**

PORTUGAL ***BRISA***

ANSWER:

Yes.

Country **Concessionaire**

GERMANY ***HERRENTUNNEL LÜBECK GMBH***

ANSWER:

No, because the EETS is not relevant for the Herrentunnel.

Country **Concessionaire**

GERMANY ***WARNOWQUERUNG GmbH & Co. KG***

ANSWER:

Not really, because the EETS is not relevant for the Warnowquerung.

Nevertheless we try to follow the activities regarding the EETS.

Our EFC system is interoperable to the other German project Herrentunnel.

Country **Concessionaire**

AUSTRIA ***ASFINAG***

ANSWER:

Yes, but at the moment all is very rudimentary and contains no real measures.

Country	**Concessionaire**
GERMANY	***Bundesamt f. Güterverkehr***
	TollCollect GmbH

ANSWER:

First considerations on interoperability have been done. It is assumed, that IR DSRC with CEN protocols will be used for all OBUs in Germany

QUESTION n. 14

Do you have plans for improving your enforcement? If yes how?

Country **Concessionaire**

ITALY ***Autostrada dei Fiori S.p.A.***

ANSWER:

No.

Country **Concessionaire**

ITALY ***Autostrade per l'Italia S.p.A.***

ANSWER:

Technical improvements are constantly made by upgrading the existing devices and software and leveraging the global service level.

Country **Concessionaire**

ITALY ***SATAP S.p.A.***

ANSWER:

Improving road police control.

Country **Concessionaire**

SPAIN ***ACESA***

ANSWER:

- Yes
- Mostly by means of EFC video surveillance

Country **Concessionaire**

SPAIN ***CINTRA***

ANSWER:

- Yes
- By means of EFC video cameras

Country **Concessionaire**

GREECE ***ATTIKES DIADROMES SA***

ANSWER:

Yes. We intent to install a video capture license plate system as a pilot only and to move for full implementation only after the Legal framework is settled in Greece.

Country **Concessionaire**

GREECE ***EGNATIA ODOS AE***

ANSWER:

Not available.

Country **Concessionaire**

GREECE ***TEO SA***

ANSWER:

EFC enforcement bilateral agreements with neighboring countries and necessary law amendments specific for EFC.

Country **Concessionaire**

PORTUGAL ***BRISA***

ANSWER:

Yes, using front and rear infrared cameras in order to get better quality in images and to improve the confidence degree when using OCR systems.

Country **Concessionaire**

GERMANY ***HERRENTUNNEL LÜBECK GMBH***

ANSWER:

No for the technology, but Yes in getting a legal framework.

Country	**Concessionaire**
GERMANY	***WARNOWQUERUNG GmbH & Co. KG***

ANSWER:

Not yet, we just improved the enforcement in the ETC lanes by installing the web cams.

Before that there was only the operator in the toll booth who was able to write down the license plate etc.

Country	**Concessionaire**
AUSTRIA	***ASFINAG***

ANSWER:

Yes, this is an ongoing process to improve the detection quality and the quality assurance for it.

Country	**Concessionaire**
GERMANY	***Bundesamt f. Güterverkehr*** ***TollCollect GmbH***

ANSWER:

There is evolutionary improvement of existing procedures and technology, but no essential changes are envisaged.

QUESTION n. 15

Do you have plans for the improvement of the cross-border enforcement?

Country **Concessionaire**

ITALY ***Autostrada dei Fiori S.p.A.***

ANSWER:

No.

Country **Concessionaire**

ITALY ***Autostrade per l'Italia S.p.A.***

ANSWER:

In order to detect foreign users nationality it is necessary to process each and every photo with very high costs for the current procedure itself. Besides, the number of controls needs telematic connection with the devoted Bodies of each country. Legal and management improvement should be made by means of agreements and creation of specific National/European agencies capable to handle common data referred to subscribers at EU level (at least).

Country **Concessionaire**

ITALY ***SATAP S.p.A.***

ANSWER:

The company has not cross-border tolling barriers.

Country **Concessionaire**

SPAIN ***ACESA***

ANSWER:

ACESA shall proceed in accordance with the EETS enforcement definition and procedures.

Country **Concessionaire**

SPAIN ***CINTRA***

ANSWER:

Cintra's staff is thinking about this issue, and will act in accordance with the Directive process.

Country **Concessionaire**

GREECE ***ATTIKES DIADROMES SA***

ANSWER:

N/A

Country **Concessionaire**

GREECE ***EGNATIA ODOS AE***

ANSWER:

Not available.

Country **Concessionaire**

GREECE ***TEO SA***

ANSWER:

EFC enforcement bilateral agreements with neighboring countries.

Country **Concessionaire**

PORTUGAL ***BRISA***

ANSWER:

Yes.

Country **Concessionaire**

GERMANY ***HERRENTUNNEL LÜBECK GMBH***

ANSWER:

We are in negotiations with the government, but our main task is to develop a legal framework for German users before we think about the foreign users.

Country	**Concessionaire**
GERMANY	***WARNOWQUERUNG GmbH & Co. KG***

ANSWER:

We are in negotiations with the government, but our main task is to develop a legal framework for German users before we think about the foreign users.

Country	**Concessionaire**
AUSTRIA	***ASFINAG***

ANSWER:

Yes, by attending the European efforts for cross border enforcement.

Country	**Concessionaire**
GERMANY	***Bundesamt f. Güterverkehr*** ***TollCollect GmbH***

ANSWER:

Within the given legal and procedural international framework, no improvements are planned. However, establishing procedures to follow up on road users for identification based on license plates (including surcharges and fines) between toll operators and authorities based on a common European legal framework would be welcome in the future.

QUESTION n. 16

Which organizations in your country or abroad should be involved in a cross-border violation?

Country **Concessionaire**

ITALY ***Autostrada dei Fiori S.p.A.***

ANSWER:

Abroad: national public register of license plates.

Country **Concessionaire**

ITALY ***Autostrade per l'Italia S.p.A.***

ANSWER:

Abroad: national public register of license plates

National agencies should have a connection with national public register (in Italy this involves the Ministry of Transport) of number plates in order to process information coming from operators who have detected a possible fraud.

Country **Concessionaire**

ITALY ***SATAP S.p.A.***

ANSWER:

Abroad: national public register of license plates.

Country **Concessionaire**

SPAIN ***ACESA***

ANSWER:

The traffic authorities as well as the motorways police.

Country **Concessionaire**

SPAIN ***CINTRA***

ANSWER:

The traffic authorities as well as the motorways police.

Country ***GREECE*** **Concessionaire** ***ATTIKES DIADROMES SA***

ANSWER:

N/A

Country ***GREECE*** **Concessionaire** ***EGNATIA ODOS AE***

ANSWER:

By law, the right belongs to public authorities and not private operators, such as police and customs office. Note that Greek land borders are with non EC countries, so a valid passport is compulsory.

Country ***GREECE*** **Concessionaire** ***TEO SA***

ANSWER:

TSP (TEO SA), Ministry of Public Order.

Country ***PORTUGAL*** **Concessionaire** ***BRISA***

ANSWER:

EP, EPE (National Highways Administration) and VVP (Via Verde Portugal).

Country ***GERMANY*** **Concessionaire** ***HERRENTUNNEL LÜBECK GMBH***

ANSWER:

Not answer.

Country ***GERMANY*** **Concessionaire** ***WARNOWQUERUNG GmbH & Co. KG***

ANSWER:

N. a.

Country ***AUSTRIA*** **Concessionaire** ***ASFINAG***

ANSWER:

ASFINAG.

Country ***GERMANY*** **Concessionaire** ***Bundesamt f. Güterverkehr*** ***TollCollect GmbH***

ANSWER:

It should be possible to find out, if a given user (identified by a vehicle's licence plate) is registered with any toll operator / contract & OBU issuer, and if so, the operator/issuer should be part of the administrative enforcement process. For all users (license plates) or at least for those that are not registered with any toll operator / OBU issuer, the relevant national authorities of the vehicles home country and of the country where the violation happened should be able to cooperate in enforcement. This process should ensure, that the user can be charged / fined based on the official vehicle registration data bases. Ideally not only vehicle registers but also registers of companies and residences should be accessable for the national authorities.

QUESTION n. 17

Which public bodies should be involved in the enforcement procedure?

Country ***ITALY*** **Concessionaire** ***Autostrada dei Fiori S.p.A.***

ANSWER:

Adroad: Road Police.

Country ***ITALY*** **Concessionaire** ***Autostrade per l'Italia S.p.A.***

ANSWER:

Abroad: Road Police

Ministry of Interiors, Ministry of Transport

Country ***ITALY*** **Concessionaire** ***SATAP S.p.A.***

ANSWER:

Abroad: Road Police.

Country ***SPAIN*** **Concessionaire** ***ACESA***

ANSWER:

National traffic authorities.

Country ***SPAIN*** **Concessionaire** ***CINTRA***

ANSWER:

National traffic authorities.

Country **Concessionaire**

GREECE ***ATTIKES DIADROMES SA***

ANSWER:

Ministry of Environment, Physical Planning & Public Works, Ministry of Public Order, Ministry of Finance, Ministry of Transportation.

Country **Concessionaire**

GREECE ***EGNATIA ODOS AE***

ANSWER:

The initial stage which has to do with the administrative issues (such as car recognition, warning letter etc) should be done by operators. Later stages (such as drivers prosecute etc) should be done by public authorities (due to law).

Country **Concessionaire**

GREECE ***TEO SA***

ANSWER:

TSP (TEO SA), Ministry of Public Order, Ministry of Finance (Eforia – the national tax system).

Country **Concessionaire**

PORTUGAL ***BRISA***

ANSWER:

EP, EPE and DGV.

Country **Concessionaire**

GERMANY ***HERRENTUNNEL LÜBECK GMBH***

ANSWER:

Not answer.

Country ***GERMANY*** **Concessionaire** ***WARNOWQUERUNG GmbH & Co. KG***

ANSWER:

N. a.

Country ***AUSTRIA*** **Concessionaire** ***ASFINAG***

ANSWER:

The ministry of interior.

Country ***GERMANY*** **Concessionaire** ***Bundesamt f. Güterverkehr*** ***TollCollect GmbH***

ANSWER:

See above description of procedure.

It seems to be important to include official register for vehicles (KBA- Kraftfahrt-Bundesamt)

QUESTION n. 18

If you do not already use it, do you plan to use video capture of license plates in case of violations?

Country ***ITALY*** **Concessionaire** ***Autostrada dei Fiori S.p.A.***

ANSWER:

Currently used.

Country ***ITALY*** **Concessionaire** ***Autostrade per l'Italia S.p.A.***

ANSWER:

Not answer.

Country ***ITALY*** **Concessionaire** ***SATAP S.p.A.***

ANSWER:

Already in use.

Country ***SPAIN*** **Concessionaire** ***ACESA***

ANSWER:

Yes.

Country ***SPAIN*** **Concessionaire** ***CINTRA***

ANSWER:

Yes.

Country ***GREECE*** **Concessionaire** ***ATTIKES DIADROMES SA***

ANSWER:

Yes.

Country ***GREECE*** **Concessionaire** ***EGNATIA ODOS AE***

ANSWER:

This is the final target.

Country ***GREECE*** **Concessionaire** ***TEO SA***

ANSWER:

Yes we already use it.

Country ***PORTUGAL*** **Concessionaire** ***BRISA***

ANSWER:

We use already video cameras.

Country ***GERMANY*** **Concessionaire** ***HERRENTUNNEL LÜBECK GMBH***

ANSWER:

We took a picture of the license plate.

Country	**Concessionaire**
GERMANY	***WARNOWQUERUNG GmbH & Co. KG***

ANSWER:

We already use video capture systems.

Country	**Concessionaire**
AUSTRIA	***ASFINAG***

ANSWER:

It is already used for automatic enforcement.

Country	**Concessionaire**
GERMANY	***Bundesamt f. Güterverkehr*** ***TollCollect GmbH***

ANSWER:

Both video capture and high resolution still pictures are used. In addition, laser scan profiles are used for classification.

QUESTION n. 19

Is the memorization and processing of the license plate numbers allowed by your legislation?

Country **Concessionaire**

ITALY ***Autostrada dei Fiori S.p.A.***

ANSWER:

Yes.

Country **Concessionaire**

ITALY ***Autostrade per l'Italia S.p.A.***

ANSWER:

Yes.

Country **Concessionaire**

ITALY ***SATAP S.p.A.***

ANSWER:

Yes. "Codice della privacy" – D. Lgs. 196/2003.

Country **Concessionaire**

SPAIN ***ACESA***

ANSWER:

Yes, but some legal restrictions apply in accordance with Privacy Law.

Country **Concessionaire**

SPAIN ***CINTRA***

ANSWER:

Yes, but some legal restrictions apply in accordance with Spanish Data Privacy Law (LOPD).

Country **Concessionaire**

GREECE ***ATTIKES DIADROMES SA***

ANSWER:

Capturing systems exist in Greece in Parking Garages and in exclusive bus lanes. There is no such system

in Attiki Odos.

Country ***GREECE*** **Concessionaire** ***EGNATIA ODOS AE***

ANSWER:
Yes.

Country ***GREECE*** **Concessionaire** ***TEO SA***

ANSWER:
It is allowed in our network. We keep records of violators (black lists) and we also have access to the national LP registration that is maintained by the Ministry of Public Order.

Country ***PORTUGAL*** **Concessionaire** ***BRISA***

ANSWER:
Yes.

Country ***GERMANY*** **Concessionaire** ***HERRENTUNNEL LÜBECK GMBH***

ANSWER:
We have a very strict legal framework regarding the privacy, so that we are not allowed to store information about our users.

Country ***GERMANY*** **Concessionaire** ***WARNOWQUERUNG GmbH & Co. KG***

ANSWER:
In case of toll violators we are allowed to store the pictures.

Country	**Concessionaire**
AUSTRIA	***ASFINAG***

ANSWER:

Yes, but with the restrictions of the data protection act: only the minimum of data is allowed to collect and process which is needed to perfom the claim, the time of storage is limited to the achievement of the purpose; the security and actuality of data have to be granted, (see the Austrian Data Protection Act 2000 based on the European Directive of Data Protection 95/46/EC 24. Oct. 1995).

Country	**Concessionaire**
GERMANY	***Bundesamt f. Güterverkehr*** ***TollCollect GmbH***

ANSWER:

Yes

QUESTION n. 20

Is the evidence of violation (content, format, etc) clearly defined?

Country	**Concessionaire**
ITALY	***Autostrada dei Fiori S.p.A.***

ANSWER:

There is no official definition of evidence of toll violation in ITALY. The elusion of toll payment is documented either by manual or electronic reports of the violation that are adopted by the Concessionaire. Also if collected the evidence of a number of frauds there is no National definition on the difference between violation (maybe happened because of technical problems) and fraud in the elusion of the toll payment. Also if a violation happen several times with intentional purpose only the intervention of the road police and judge can define what is the evidence sufficient to prove the transition from violation to fraud.

Country	**Concessionaire**
ITALY	***Autostrade per l'Italia S.p.A.***

ANSWER:

There is no official definition of evidence of toll violation in Italy. The elusion of toll payment is documented either by manual or electronic reports of the violation that are adopted by the Concessionaire. Also if collected the evidence of a number of frauds there is no National definition on the difference between violation (maybe happened because of technical problems) and fraud in the elusion of the toll payment. Also if a violation happen several times with intentional purpose only the intervention of the road police and judge can define what is the evidence sufficient to prove the transition from violation to fraud.

Country	**Concessionaire**
ITALY	***SATAP S.p.A.***

ANSWER:

There is no official definition of evidence of toll violation in ITALY. The elusion of toll payment is documented either by manual or electronic reports of the violation that are adopted by the Concessionaire. Also if collected the evidence of a number of frauds there is no National definition on the difference between violation (maybe happened because of technical problems) and fraud in the elusion of the toll payment. Also if a violation happen several times with intentional purpose only the intervention of the road police and judge can define what is the evidence sufficient to prove the transition from violation to fraud.

Country **Concessionaire**

SPAIN ***ACESA***

ANSWER:

It is on its way. A full definition is expected soon.

Country **Concessionaire**

SPAIN ***CINTRA***

ANSWER:

The work is currently in progress. A technical definition should be available some time from now.

Country **Concessionaire**

GREECE ***ATTIKES DIADROMES SA***

ANSWER:

Not at all.

Country **Concessionaire**

GREECE ***EGNATIA ODOS AE***

ANSWER:

Not available.

Country **Concessionaire**

GREECE ***TEO SA***

ANSWER:

The evidence of violation is clearly defined internally, but not through formal legislation.

Country **Concessionaire**

PORTUGAL ***BRISA***

ANSWER:

Yes.

Country ***GERMANY***

Concessionaire ***HERRENTUNNEL LÜBECK GMBH***

ANSWER:

We use a picture of the license plate.

No other regulation is known.

Country ***GERMANY***

Concessionaire ***WARNOWQUERUNG GmbH & Co. KG***

ANSWER:

No official legal definition of the evidence, but in general a picture of the vehicle including the license plate is used.

Country ***AUSTRIA***

Concessionaire ***ASFINAG***

ANSWER:

Yes.

Country ***GERMANY***

Concessionaire ***Bundesamt f. Güterverkehr***
TollCollect GmbH

ANSWER:

Not answer.

QUESTION n. 21

Do privacy restrictions apply to EFC enforcement and to what extent?

Country	**Concessionaire**
ITALY	***Autostrada dei Fiori S.p.A.***

ANSWER:

Autostrade per l'Italia that is the issuer of all the Italian EFC contracts put into the contracts the reference to the privacy law.

Country	**Concessionaire**
ITALY	***Autostrade per l'Italia S.p.A.***

ANSWER:

Yes; in Italy violation data (i.e. number plate, vehicle owner,..) are usable only if a tentative fraud is detected and this proof must accompany the entire procedure eventually up to the Court. It is allowed to take picture only of rear plate and of some part of vehicle in order to detect color and brand/model of vehicle for further investigation. It is not allowed to process pictures showing the interior of vehicle in some extent. The prosecuted user is in any case the vehicle's owner. No context camera shot is allowed.

In some cases abroad no picture of any vehicle is allowed, in some other the responsible of violation is the actual driver of vehicle.

Country	**Concessionaire**
ITALY	***SATAP S.p.A.***

ANSWER:

In order to Italian law (D. Lgs. 196/2003).

Country	**Concessionaire**
SPAIN	***ACESA***

ANSWER:

According to Spanish law, access to national plate register cannot be done automatically or on a regular basis by concessionaires. A permit from traffic authorities is required.

Country	**Concessionaire**
SPAIN	***CINTRA***

ANSWER:

According to Spanish law, access to national plate register can not be done automatically or on a regular basis by private-owned toll operators. A permit from traffic authorities is required.

Country	**Concessionaire**
GREECE	***ATTIKES DIADROMES SA***

ANSWER:

Yes. Data need to be protected as prescribed by the Personal Data Protection Laws.

Country	**Concessionaire**
GREECE	***EGNATIA ODOS AE***

ANSWER:

Yes. The legal framework is still vague due to the Personal Data Protection Law.

Country	**Concessionaire**
GREECE	***TEO SA***

ANSWER:

Yes. There is actually the Personal Data Protection Laws in force that requires that vehicle pictures should present the rear part of the vehicle. Pictures should not include passengers or drivers face.

Country	**Concessionaire**
PORTUGAL	***BRISA***

ANSWER:

Yes.

Country	**Concessionaire**
GERMANY	***HERRENTUNNEL LÜBECK GMBH***

ANSWER:

Yes, because the legal framework is so complex and restricted we will use barriers.

Country	**Concessionaire**
GERMANY	***WARNOWQUERUNG GmbH & Co. KG***

ANSWER:

Yes, because the legal framework is so complex and restricted we will use barriers.

Country	**Concessionaire**
AUSTRIA	***ASFINAG***

ANSWER:

Yes, in the same way as described above for the storage and processing the license plate and the correspondin data.

Country	**Concessionaire**
GERMANY	***Bundesamt f. Güterverkehr*** ***TollCollect GmbH***

ANSWER:

Not answer.

QUESTION n. 22

Could you think about future barrier-less EFC in your country (if not already performed)? Which impact could have on your organization this application? Which change in the enforcement procedures?

Country ***ITALY*** **Concessionaire** ***Autostrada dei Fiori S.p.A.***

ANSWER:
No.

Country ***ITALY*** **Concessionaire** ***Autostrade per l'Italia S.p.A.***

ANSWER:
Yes; a possible multilane EFC system can partially replace in the future the current channelised system. Current motorways could be equipped with a dual/tri virtual lane gantry wherever two or three ETC adjacent lanes can be found at barriers or stations. This would not likely change much the current procedures.
Future motorways could be equipped with new generation pure Multilane dynamic DSRC systems, but in this case a secure enforcement will be possible only if , by Governmental law, the user is forced to be equipped with an OBU

Country ***ITALY*** **Concessionaire** ***SATAP S.p.A.***

ANSWER:
?

Country ***SPAIN*** **Concessionaire** ***ACESA***

ANSWER:
Not until a full and effective scheme for EFC enforcement and fraud prosecution is available. Such a system must be agreed and accepted on a pan-European basis before barriers can be removed.

Country ***SPAIN*** **Concessionaire** ***CINTRA***

ANSWER:
Removing barriers from EFC toll lanes would create a very serious impact on our organization and will

definitely require a well defined and tested enforcement procedure, based on a cost-effective technology and accepted in full by all European member-States. Unless these conditions hold we believe that such approach to EFC is not feasible.

Country **Concessionaire**

GREECE ***ATTIKES DIADROMES SA***

ANSWER:

Because of growing congestion, a barrier-less EFC system is a must not only for Attiki Odos but for other projects also. However, unless a clear legal framework related to EFC enforcement is implemented our toll revenue will not be secured at all and therefore the barrier-less system will not be feasible. Barrier-less is a must for the future in our Organization.

Country **Concessionaire**

GREECE ***EGNATIA ODOS AE***

ANSWER:

Yes. Legal framework needs to be clear, as well as rights and procedures have to be defined first.

Country **Concessionaire**

GREECE ***TEO SA***

ANSWER:

Improvement of a European-wide legal framework related to EFC cross border enforcement. Greece will be a very interesting case since it is the entry/exit point for substantial non-EU traffic.

Country **Concessionaire**

PORTUGAL ***BRISA***

ANSWER:

Portugal is working already with barrier-less EFC.

Country **Concessionaire**

GERMANY ***HERRENTUNNEL LÜBECK GMBH***

ANSWER:

Free flow is no alternative in the future unless the legal framework will not allow the prosecution from foreign users, too.

Country **Concessionaire**

GERMANY ***WARNOWQUERUNG GmbH & Co. KG***

ANSWER:

We are still thinking to remove the barriers in the EFC lanes but what we need is a legal framework for both prosecution of national and international users.

Country **Concessionaire**

AUSTRIA ***ASFINAG***

ANSWER:

It is already barrier less from the very beginning.

Country **Concessionaire**

GERMANY ***Bundesamt f. Güterverkehr***
TollCollect GmbH

ANSWER:

The German system already is a totally barrier-less multi-lane free-flow system.

In the German system, state of the art enforcement equipment is used, and now revolutionary changes are foreseen, also not for the case of European electronic tolling service. However, some adoption of organizational and technical interfaces for an interoperable world are foreseen (esp. some new interfaces).

6.3 Enforcement Situations Analysis

This chapter has for aim the identification of the possible violations in an European EFC system and the procedures to unchain in terms of enforcement as reply to each one of them. In this scope, Recommendations on possible enforcement technologies will also be included.

6.3.1 INTRODUCTION

In this chapter a matrix is presented which intends to be the starting point for the definition of the enforcement model under an interoperable scenario. This model, supposed to be implemented in the different state-members, results from a set of initiatives that have been promoted by international entities and associations, as ASECAP (*Association européenne des Concessionnaires d'Autoroutes, des Ponts, des Tunnels et des Ouvrages à Péage* - European Association of Companies with Concessions for Motorway, Bridge and Tunnel Tolls) and Stockholm Group. This matrix should be used as an orientation for the identification of the enforcement that can be used for each specific enforcement functionality.

The first step in defining the enforcement system to be implemented is to identify the possible toll violation scenarios that can occur in the different EFC systems already in operation and that will be part of the EETS.
All identified violation scenarios ("Type of Situation") are evaluated for the different type of installed EFC System.

Relatively to the Type of Situation that can occur, the used classification was based in the following types:

- No OBU / No receipt of booking system: Situations in which neither an OBU is detected inside of the vehicle nor a receipt of an alternative charging method (like a booking system) can be found when the vehicle is passing by an enforcement point. In some contexts, a post-registration and payment has been chosen (e.g. London and Stockholm Congestion Charges), so that in this case passing of a vehicle will be recorded and verified against a receipt in the booking system after the post-registration period.

- Discrepancy between declared parameters (OBU or declaration in booking system) and determined parameters (measurement by RSE, mobile enforcement or database retrieval): Situations in which the declared vehicle's data registered in the OBU or declared in the booking system do not correspond to the data determined at the enforcement point (for example, discrepancy between the determined parameters for the definition of the tariff class and the parameters registered in the OBU which may define the vehicle's tariff class).

- Routes: Set of situations in which there is an inconsistence in the route made (for example, in an EFC with technology GNSS, inconsistency of the co-ordinates in a determined period of time).

- Equipment malfunction: Situations that occurs due to the failure on the equipment (OBU and/or RSE and Control Unit).

- Attempt to inhibit the payment/enforcement: Situations that occur when the user deliberately takes actions to avoid the payment and/or to inhibit the constitution of evidence of a violation.

Regarding the "Type of Installed EFC Technology", the technologies considered in this document are those that were implemented in the countries involved in the present initiative:

- DSRC Mono-lane: Electronic fee collection made by a DSRC system, existent in the toll plazas with specific lanes for equipped users (for example, the case of Portugal, Spain, Italy, France, etc).

- DSRC Multi-lane: Electronic fee collection made by a DSRC system, where there are no physical barriers neither specific lanes - concept of free traffic flow (for example, the case of Austria). No toll-specific speed limitations imposed at location of DSRC beacon.

- GNSS-CN: System based on the collection of fee/toll due to the utilization of the roads based on a satellite system complemented with CN and DSRC (Microwave or Infrared) technologies (for example, the case of Germany: GSM and IR).

- Booking System: Systems that include a pre-pay booking system (for example the case of Germany and Austria).

- Odometer: System of collection based in the distance driven, read from the tachograph supported by a GPS technology (for example, the case of Switzerland).

For a representative set of situations, selected from all identified situations, a detailed analysis was made in which the following elements were contemplated:

- Situation description: Description of the situation and the cases in which it may happen;

- Methods for identification of the violation: Identification of recommended means for the verification of the compliance and/or identification of violation situations;

- Technology requirements that assure the identification of the violation: Identification of the equipment and support systems (for example, monitoring databases or files) that allow the verification of the vehicle passage according with the expected result or, in opposite, a vehicle passage in violation;

- Methods to constitute evidence of violation and/or identification of the violator: Analysis of the mechanisms and methods that should be used as evidence of the violation and identification of the violator;

- Technology requirements for the constitution of evidence and / or identification of the violator: In this point, it is materialized, in terms of equipment and support systems (for example, systems for license plate recognition), the method for the constitution of the evidence of the violation and how the violator will be identified.

- Procedures for the regularization of the situation: Lines of orientation that should be taken under the definition of the procedure for the regularization of the situation, either by the users (national or non-national), either by the other involved entities (TSP/Principal, CI, EFCO).

The analysis of these particular situations aims to define the required procedures to implement in order to avoid EETS violations and to regularize situations that may happen, and to determine the possible technologies that may be used for each specific enforcement situation.

6.3.2 POSSIBLE SITUATIONS ANALYSIS

This chapter should cover the identification and description of the possible EETS violations that may take place and the detailed analysis of each one of them, as supplied template and enclosed examples.

The identified situations are identified and described in the following matrix.

SITUATION DESCRIPTION	TYPE OF INSTALLED EFC TECHNOLOGY					EXAMPLE
	DSRC MONO-LANE	DSRC MULTI-LANE	GNSS-CN	BOOKING SYSTEM	TACHOGRAPH	
NO OBU / RECEIPT OF BOOKING SYSTEM						
No OBU This situation occurs when a vehicle passes an EFC enforcement point and no active and correctly working OBU is detected inside it. This situation can happen in any of the implemented EFC systems already implemented in Europe, once all of them contemplate the existence of an OBU in the adherent vehicles to the system.	√	√	√		√	6.3.2.1.1
Vehicle without OBU and not registered in the Booking System This situation occurs when a vehicle passes an EFC enforcement point and no active and correctly working OBU is detected inside it. This situation can happen in those of the EFC systems already implemented in Europe which also allow alternative manual booking of a trip.	√	√	√	√		6.3.2.1.2
DISCREPANCY BETWEEN DECLARED PARAMETERS AND DETERMINED PARAMETERS						
License plate number registered in the OBU does not meet the	√	√	√		√	6.3.2.1.3

Situation Description	Type of Installed EFC Technology					Example
	DSRC Mono-Lane	DSRC Multi-Lane	GNSS-CN	Booking System	Tachograph	
real one This situation occurs when it is detected an inconsistency between the license plate number registered on the OBU and the vehicle license plate read by the RSE.						
License plate number registered on the Booking System different from the one read This situation occurs when an incorrect license plate number has been registered on the booking system.				√		6.3.2.1.4
Discrepancy between the declared and the determined parameters that define the vehicle tariff class This situation takes place when the tariff class's parameters declared on the OBU or in the booking system do not meet the ones determined by the enforcement system (that could be RSE, mobile enforcement or database retrieval).	√	√	√	√	√	6.3.2.1.5
Number of axles declared in the OBU or in the booking system different from the one determined by enforcement system This situation takes place when the number of axles declared in the OBU or in the booking system does not meet the one determined by the enforcement system (that could be RSE, mobile enforcement or database retrieval).	√	√	√	√	√	6.3.2.1.6
(Legal Maximum laden) Weight of the tractor unit declared in the OBU or in the booking system different from the one determined by the enforcement system	√	√	√	√	√	6.3.2.1.7

Situation Description	Type of Installed EFC Technology					Example
	DSRC Mono-Lane	DSRC Multi-Lane	GNSS-CN	Booking System	Tachograph	
This situation takes place when legal maximum laden weight declared on the OBU or in the booking system do not meet the one determined by the enforcement system. The regularities regarding the obligation to pay depending on the maximum laden weight (MLW) can be different in the tolling systems, e.g. MLW of pulling vehicle, MLW of combination.						
(Legal Maximum laden) Weight of the trailer declared in the OBU or in the booking system different from the one determined by the enforcement system This situation takes place when legal maximum laden weight declared on the OBU or in the booking system do not meet the one determined by the enforcement system.	√	√	√	√	√	6.3.2.1.8
(Legal Maximum laden) Weight of the combination (tractor and trailer) declared in the OBU or in the booking system different from the one determined by the enforcement system This situation takes place when legal maximum laden weight declared on the OBU or in the booking system do not meet the one determined by the enforcement system.	√	√	√	√	√	6.3.2.1.9
Type of suspension is different from the one registered in the OBU or in the booking system This situation occurs when the type of suspension of the vehicle is not the one registered on the OBU. (Suspension means here the springs and the shock absorber system of the vehicle. The reason is that it has a relevant impact on the wear of the surface of the	√	√	√	√	√	6.3.2.1.10

Situation Description	Type of Installed EFC Technology					Example
	DSRC Mono-Lane	DSRC Multi-Lane	GNSS-CN	Booking System	Tachograph	
road.).						
Type of fuel is different from the one registered in the OBU or in the booking system This situation takes place if fuel type declared on the OBU or in the booking system does not meet the one determined by the enforcement system (that could be RSE, mobile enforcement or database retrieval) or if a vehicle that is eligible to toll based on fuel type does not pay toll. (Remark: This is being discussed in some new national schemes, e.g. that only diesel driven trucks will be eligible both to tolling as well as to fuel tax refund, but not trucks driven by other fuels or means).	√	√	√	√	√	6.3.2.1.11
Emission class is different from the one declared in the OBU or in the booking system This situation takes place if the emission class declared on the OBU or in the booking system does not meet the one determined by the enforcement system (that could be RSE, mobile enforcement or database retrieval) or if a vehicle that is eligible to toll based on emission class does not pay toll.	√	√	√	√	√	6.3.2.1.12
Dual-tire vehicle condition is not properly recorded in the OBU The situation may occur when a dual-tire HGV enters a toll motorway without its OBU dataset being consistent with its wheel configuration and this is detected by classification/enforcement equipment.	√	√				6.3.2.1.13

Situation Description	Type of Installed EFC Technology					Example
	DSRC Mono-Lane	DSRC Multi-Lane	GNSS-CN	Booking System	Tachograph	
Equipment malfunction						
Problems in OBU reading and Communication Interference between the RSE and the OBU Situation that could occur when a vehicle passes an enforcement point and the RSE could not read the information registered on the OBU.	√	√	√		√	6.3.2.1.14
No success in storing the entry toll code in the OBU This situation can take place when a vehicle passes an electronic entry toll gate and the RSE is not able to write information about that toll road entry point on the OBE.	√ (closed toll systems)	√ (closed toll systems)				6.3.2.1.15
GNSS receiver malfunction This situation occurs when the GNSS receiver installed on the vehicle is not working properly and, for that reason, the OBU does not identify the use of a toll road. In that case no toll transactions and no payments are processed.			√	√		6.3.2.1.16
Routes / Courses inconsistencies						
Passing an exit toll without information about the entrance Situation that can occur when a vehicle passes an exit toll and the OBU installed has no information on the entrance toll. This situation is only applicable to closed DSRC toll systems.	√ (closed toll systems)	√ (closed toll systems)				6.3.2.1.17
Inconsistent time/ and place sequences This situation takes place if observations of the vehicle based on LPN						6.3.2.1.18

Situation Description	Type of Installed EFC Technology					Example
	DSRC Mono-Lane	DSRC Multi-Lane	GNSS-CN	Booking System	Tachograph	
at various times/locations by the enforcement system (that could be RSE, mobile enforcement or database retrieval) are not physically or logically possible or conclusive. This could e.g. be an entry to the road system without an exit, an exit without entry, or observations that imply impossible/improbable speeds, …	√ (closed toll systems)	√ (closed toll systems)	√			
Vehicle registered in the booking system but whose payment is insufficient This situation is possible to take place in systems that include booking scheme and it is verified when a vehicle is found in circulating in a motorway or passes an enforcement point outside the scope of the pre-registry previously made.				√		6.3.2.1.19
Vehicle registered in the booking system but whose route is different from the one declared This situation is possible in systems that allow pre-booking, where the actual route is different (and more expensive) than the registered one.				√		6.3.2.1.20
Attempt to Inhibit the Payment/Enforcement						
License plate hidden / illegible (attempt to inhibit the payment or enforcement) This situation occurs when the vehicle does not have a license plate or it is covered or it is deteriorated, by usage or by deliberate intention.	√	√	√	√	√	6.3.2.1.21
“Little train” / “Piggybacking” / “Tailgating” (attempt of inhibition of payment) Situation that occurs when a vehicle (with or without OBU) passes in a	√	√				6.3.2.1.22

Situation Description	Type of Installed EFC Technology					Example
	DSRC Mono-Lane	DSRC Multi-Lane	GNSS-CN	Booking System	Tachograph	
toll gate or a multi-lane gantry very close to the vehicle that follows at its front, with the objective to hinder that the system recognizes the two vehicles, reading and storing information only in the OBU of the vehicle in front.						
“Little train” / “Piggybacking” / “Tailgating” (attempt of inhibition of enforcement) Situation similar to the previous one, but where the only vehicle that has OBU is the one that follows behind. Although activated, the enforcement system will only capture an image of the vehicle which follows behind and when the means of identification of the violator is initiated, it is verified that the OBU belongs to a adherent, not having, therefore, the necessary information to recover any value. The vehicle of the front will pass, this way, unpunished.	√	√			√	6.3.2.1.23
Two vehicles side-by-side (attempt of inhibition of payment) Situation that occurs when two vehicles (for example, an automobile of passengers and one motorcycle) pass a toll gate or multi-lane gantry side-by-side.	√					6.3.2.1.24
Speed above permissible one (attempt of inhibition of payment/enforcement) Speed above allowed (attempt of inhibition of payment/enforcement). Situations in which one vehicle passes a toll gate or a multi-lane gantry at a speed above of the permissible for the reading by the RSE.	√	√			√	6.3.2.1.25
Others						

SITUATION DESCRIPTION	TYPE OF INSTALLED EFC TECHNOLOGY					EXAMPLE
	DSRC MONO-LANE	DSRC MULTI-LANE	GNSS-CN	BOOKING SYSTEM	TACHOGRAPH	
OBU low battery This situation happens when a vehicle registered with the EETS enters a toll gate or gantry and it cannot perform an EETS transaction due to a shortage in the OBU energy supply. It must be realized that in this case the user may not intend to commit an offense.	√	√	√			6.3.2.1.26
OBU with no valid contract This situation occurs when a vehicle is equipped with an OBU but there is no valid contract registered in the system.	√	√	√		√	6.3.2.1.27
OBU software/firmware or data not up to date or invalid This situation occurs when a vehicle is equipped with an OBU but invalid/outdated Software or Data (e.g. Geo Data, Tariff Data, …) prevent correct functioning of OBU.	√	√	√			6.3.2.1.28
OBU identified in the *black list* Situation that occurs when a vehicle whose OBU is registered in a "black list" passes a toll gate (in a barrier less system) or other enforcement point.	√	√	√		√	6.3.2.1.29
OBU with *video flag* on Situation that occurs when a vehicle, whose OBE's wanted flag is set on, passes a toll gate or other enforcement point. In this cases a picture of that vehicle has to be taken in any case.	√	√	√			6.3.2.1.30
OBU with *tampering flag* on This situation happens when a vehicle registered with the EETS enters a designated toll gate or gantry but it cannot perform an EETS	√	√	√		√	6.3.2.1.31

SITUATION DESCRIPTION	TYPE OF INSTALLED EFC TECHNOLOGY					EXAMPLE
	DSRC MONO-LANE	DSRC MULTI-LANE	GNSS-CN	BOOKING SYSTEM	TACHOGRAPH	
transaction due to a malicious alteration of the OBU. It must be realized that in this case the user may deliberately intend to commit an offense or even a fraud.						
OBU not supporting the RSE Enforcement Protocols This situation occurs when an OBU does not support the RSE enforcement protocols (or it supports it but not the correct version) restricting the enforcement capabilities of the road service provider to the OBUless case (e.g, photograph, visual inspection, etc).	√	√	√			6.3.2.1.32

Some of these situations were exhaustively analyzed by the EG10 Task2 members and are detailed in the next sections. This analysis established a set of rules and procedures for identification of the violation and identification the violator, constitution of evidences on violations and regularization of the values in debt. This rules and procedures are evidenced in the main body of this report and should be implemented in order to guarantee that the enforcement system really works in a barrier-less environment.

6.3.2.1 POSSIBLE VIOLATIONS DETAILED ANALYSIS

6.3.2.1.1 No OBU

SITUATION	This situation occurs when a vehicle passes an EFC enforcement point and no active and correctly working OBU is detected inside it. This situation can happen in any of the implemented EFC systems already implemented in Europe, once all of them contemplate the existence of an OBU in the adherent vehicles to the system.

IDENTIFICATION OF THE VIOLATION

MEANS

A situation like this should be detected by the DSRC/IR roadside equipment (in systems that include toll gates or gantries for tolling enforcement) or by patrol units (in systems that include this kind of enforcement).

In what concerns the road-side equipment-based enforcement, the identification of the violation should be done as follows:

- The incoming vehicle is detected;
- The RSE is not able to initiate a EETS transaction due to lack of the OBU;
- If the time window allows, further intents from the RSE are tried but still unsuccessful;
- The vehicle trespasses the toll gate/gantry.

or

- The incoming vehicle is detected
- The RSE initiates a transaction with an OBU
- The information gathered indicates that the OBU is inactive or not working properly as indicated to the user

If the enforcement is done by patrol units, the enforcement team should have the needed equipment in order to detect the presence (or not) of an OBU installed in the vehicle.

TECHNOLOGY REQUIREMENTS

The recommended technology requirements are determined by the type of enforcement point: toll gates / enforcement gantries or patrol units.

Toll Gates / Multi-lane Gantries:

In this case, the technology requirements that should be guaranteed are:

- Equipment for automatic vehicle detection (as tri-dimensional scanners, loops, pressure detectors,…);
- DSRC equipment (DSRC *beacon*) to read/detect the OBU.

Patrol Units:

If we consider the enforcement made by the patrol-cars, the technology requirements are:

- DSRC portable equipment (DSRC *mobile system*) to read/detect the OBU.

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

When enforcement is made at toll gates or multi-lane gantries, the evidence should be built upon the information collected by the RSE (by electronic means), associated to a digital photograph (with information about the time and place of the event). When the enforcement is made through mobile means, the vehicle involved in a violation should be stopped in order to regularize the situation, so that it will be unnecessary to constitute further evidence of the violation.

The identification of the violator (vehicle with a national plate), will be carried out in two consecutive steps:

1) Through the search of information concerning the owner of the vehicle in the EETS adherents' database; the CI should be able to look it up, accessing the information needed about registered vehicles and their owners.
2) If it happens (as it is most likely) that the vehicle is not registered with the EETS, the information must be retrieved from external sources as indicated in the entry "Technology Requirements – Identification of Violator".
3) If a communication with the OBU was possible, but OBU deactivated or not working properly, this information can be used in addition to identify the violator

In case of dealing with a non-national vehicle, the CI/TSP/EFCO should collect all violation's evidences and use international communication networks (see "Technology Requirements - Identification of Violator") in order to solve the situation with the CI of the country identified by reading the license plate.

TECHNOLOGY REQUIREMENTS

Considering what was stated on the previous entry, evidence of the violation and violator ID will be required only when the enforcement is triggered at the toll gates or multi-lane gantries. In these cases, the technology to install should meet to the following needs:

Evidence constitution:

- Image capture equipment (the equipment should be certified in the following capabilities: sensitiveness, accuracy, synchronicity, integrity);
- Systems for automatic license plate recognition;
- Database to collect data related to the violation (time and place information, license plate number, information gathered from OBU,…);
- Encryption for privacy and law compliance (digital signature or watermark).

Identification of violator:

- Black list database (if allowed by national law);
- For national vehicles: access to the national register or any other electronic means legally possible (insurance or vehicle technical inspection records);
- For non-national vehicles: means for an effective and reliable handover of the violation information evidence to the CI European network or to the traffic authorities in the corresponding state-member.

PROCEDURE TO VIOLATION PURSUANCE

The procedure to regularize the situation should be as follows, depending on the nationality of the vehicle:

National Vehicles:

- Identification of the vehicle owner;
- Notification of the violation (via sms, phone call, letter, registered letter, etc.) in order to warn the vehicle owner of the necessity to regularize the situation - this notification can assume different degrees of reliability, as the intended level of insistence (for example, a phone call allows a higher reliability degree than a sms). In case the vehicle owner and the driver are not the same person, it would be necessary also to request from the former the driver ID;
- The information recorded on the violation must be verified in order to collect historical data about relapses;
- In case that the owner of the vehicle or its driver fail to make the necessary effort to regularize the situation, each country should be free to define what actions should take place, either administrative or jurisdictional.

Non-National Vehicles (inside UE):

- Identification of the origin country of the vehicle involved in the violation;
- Sending the related information and evidence on the previously verified violation to the corresponding international CI so that it can initiate the regularization process. This can be done by means of a privately dedicated European network (real or virtual), i.e the eNFORCE network defined on VERA2 report. The process must follow the guidelines described above for national vehicles.
- When the vehicle involved does not belong to the EU the national CI must hand the violation information and evidence over the traffic authorities. If there is a bilateral protocol governing traffic offence information exchange between both countries the operator must check if it requires any particular action to be taken from its own, otherwise authorities should be able to handle the issue.

RECOMMENDATIONS

- The tolled motorways should have manual lanes available for vehicles that are not adherents to the EFC system or do not have an OBU installed.
- The use of digital cameras to build violation evidence is strongly recommended as mostly appropriate. It is important to note in this respect that some state-members legislation needs to be reviewed and adapted to this requirement.
- The CI must keep a database with information concerning national EETS adherents that allow their identification in case of verification of irregularities (as for example a registered vehicle not being able to interact properly with the roadside equipment). This database should include information on owner identification and contact and must be updated regularly.
- For international violations it is recommended to define an entity in charge to initiate the cross-border procedure for toll recovery. In this respect the state members must agree the procedure for the recovery of the amounts indebted by non-national citizens to national CI.
- It should be promoted the use of a private and dedicated network for communication between the different EETS actors. This network must include systems, applications and templates of documents and procedures so that the sharing of information could be effectively done. In this scope, should be used the eNFORCE network, defined in the

VERA2 report.

- It should be assessed the feasibility of a regulatory/certification European organization entitled to address all issues regarding enforcement legal procedures, international relations between EETS players, etc..
- It should be defined the procedures and penalties for vehicle's owners with a valid EFC contract that uses the service with no OBU.
- It should be considered a fixed and non-removable installation of the OBUs to vehicles, in order to avoid some irregular / violation situations.
- In case of mobile enforcement the vehicle should be stopped by officials with executive powers given to them by law, including the right and means to demand on-the-spot deposits (cash, card payment) or to hold the vehicle until a deposit has been received and/or other legal action has been concluded.

6.3.2.1.2 Vehicle without OBU and not registered in the booking system

SITUATION	This situation occurs when a vehicle passes an EFC enforcement point and no active and correctly working OBU is detected inside it. This situation can happen in those of the EFC systems already implemented in Europe which also allow alternative manual booking of a trip.

IDENTIFICATION OF THE VIOLATION

MEANS

A situation like this should be detected by the DSRC/IR roadside equipment (in systems that include toll gates or gantries for tolling or enforcement) or by patrol units (in systems that include this kind of enforcement).

In what concerns the road-side equipment-based enforcement, the identification of the violation should be done as follows:

The incoming vehicle is detected;

The RSE is not able to initiate a EETS transaction due to lack of the OBU or OBU is deactivated or not working properly;

The existence of a valid booking consistent with the observations is checked in the central database;

In case of post registration, this can be finally done only after the post registration period has terminated.

If the enforcement is done by patrol units, the enforcement team should have the needed equipment in order to detect the presence and correct function (or not) of an OBU installed in the vehicle.

TECHNOLOGY REQUIREMENTS

The recommended technology requirements are determined by the type of enforcement point: toll gates / enforcement gantries or patrol units.

Toll Gates / Multi-lane Gantries:

In this case, the technology requirements that should be guaranteed are:

- Equipment for automatic vehicle detection (as tri-dimensional scanners, loops, pressure detectors,…);
- DSRC equipment (DSRC *beacon*) to read/detect the OBU.
- Communication to central database for bookings

Patrol Units:

If we consider the enforcement made by the patrol-cars, the technology requirements are:

- DSRC portable equipment (DSRC *mobile system*) to read/detect the OBU.
- Mobile Data and Communication equipment to check central database for valid booking and to flag down violator's vehicle and equipment to take deposits as cash and card payments

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

When enforcement is made at toll gates or multi-lane gantries, the evidence should be built upon the information collected by the RSE (by electronic means), associated to a digital photograph (with information about the time and place of the event). When the enforcement is made through mobile means, the vehicle involved in a violation should be stopped in order to regularize the situation, so that it will be unnecessary to constitute further evidence of the violation. This includes checking proof of booking (e.g. booking number, ticket, …) carried by the driver in a pre-registration scheme.

The identification of the violator (vehicle with a national plate), will be carried out in two consecutive steps:

4) Through the search of information concerning the owner of the vehicle in the EETS adherents' database; the CI should be able to look it up, accessing the information needed about registered vehicles and their owners.
5) If it happens (as it is most likely) that the vehicle is not registered with the EETS, the information must be retrieved from external sources as indicated in the entry "Technology Requirements – Identification of Violator".

In case of dealing with a non-national vehicle, the CI/TSP/EFCO should collect all violation's evidences and use international communication networks (see "Technology Requirements - Identification of Violator") in order to solve the situation with the CI of the country identified by reading the license plate.

TECHNOLOGY REQUIREMENTS

Considering what was stated on the previous entry, evidence of the violation and violator ID will be required only when the enforcement is triggered at the toll gates or multi-lane gantries. In these cases, the technology to install should meet to the following needs:

Evidence constitution:

- Image capture equipment (the equipment should be certified in the following capabilities: sensitiveness, accuracy, synchronicity, integrity);
- Systems for automatic license plate recognition;
- Database to collect data related to the violation (time and place information, license plate number,information gathered from OBU …);
- Encryption for privacy and law compliance (digital signature or watermark).

Identification of violator:

- Black list database (if allowed by national law);
- For national vehicles: access to the national register or any other electronic means legally possible (insurance or vehicle technical inspection records);
- For non-national vehicles: means for an effective and reliable handover of the violation information evidence to the CI European network or to the traffic authorities in the corresponding state-member.

PROCEDURE TO VIOLATION PURSUANCE

The procedure to regularize the situation should be as follows, depending on the nationality of the vehicle:

National Vehicles:

- Identification of the vehicle owner;
- Notification of the violation (via sms, phone call, letter, registered letter, etc.) in order to warn the vehicle owner of the necessity to regularize the situation - this notification can assume different degrees of reliability, as the intended level of insistence (for example, a phone call allows a higher reliability degree than a sms). In case the vehicle owner and the driver are not the same person, it would be necessary also to request to the former the driver ID;
- The information recorded on the violation must be verified in order to collect historical data about relapses;
- In case that the owner of the vehicle or its driver fail to make the necessary effort to regularize the situation, each country should be free to define what actions should take place, either administrative or jurisdictional.

Non-National Vehicles (inside UE):

- Identification of the origin country of the vehicle involved in the violation;
- Sending the related information and evidence on the previously verified violation to the corresponding international CI so that it can initiate the regularization process. This can be done by means of a privately dedicated European network (real or virtual), i.e the eNFORCE network defined on VERA2 report. The process must follow the guidelines described above for national vehicles.
- When the vehicle involved does not belong to the EU the national CI must hand the violation information and evidence over the traffic authorities. If there is a bilateral protocol governing traffic offence information exchange between both countries the operator must check if it requires any particular action to be taken from its own, otherwise authorities should be able to handle the issue.

RECOMMENDATIONS

- The use of digital cameras to build violation evidence is strongly recommended as mostly appropriate. It is important to note in this respect that some state-members legislation needs to be reviewed and adapted to this requirement.
- The CI must keep a database with information concerning national EETS adherents that allow their identification in case of verification of irregularities (as for example a registered vehicle not being able to interact properly with the roadside equipment). This database should include information on owner identification and contact and must be updated regularly.
- For international violations it is recommended to define an entity in charge to initiate the cross-border procedure for toll recovery. In this respect the state members must agree the procedure for the recovery of the amounts indebted by non-national citizens to national CI.
- It should be promoted the use of a private and dedicated network for communication between the different EETS actors. This network must include systems, applications and templates of documents and procedures so that the sharing of information could be effectively done. In this scope, should be used the eNFORCE network, defined in the VERA2 report.
- It should be assessed the feasibility of a regulatory/certification European organization entitled to address all issues regarding enforcement legal procedures, international relations between EETS players, etc..
- It should be defined the procedures and penalties for vehicle's owners with a valid EFC contract that uses the service with no OBU.
- It should be considered a fixed and non-removable installation of the OBUs to vehicles, in order to avoid some

irregular / violation situations.

- In case of mobile enforcement the vehicle should be stopped by officials with executive powers given to them by law, including the right and means to demand on-the-spot deposits (cash, card payment) or to hold the vehicle until a deposit has been received and/or other legal action has been concluded.

6.3.2.1.3 License plate number registered in the OBU does not meet the real one

SITUATION	This situation occurs when it is detected an inconsistency between the license plate number registered on the OBU and the vehicle license plate read by the RSE.

IDENTIFICATION OF THE VIOLATION

MEANS

To identify this situation, it is necessary that, at the toll gate/gantry or check-point, the RSE be able to detect a vehicle passing through and read the data recorded on the OBU (including the license plane number). Additionally, it should be able to capture an image of the vehicle and to process the license plate number. When comparing the license plate number obtained from the two origins (OBU and picture), the RSE must detect that there is an inconsistency between them.

The enforcement made by mobile units is also supposed to read the information recorded on the OBU in order to compare it to the visual recognition made by the patrol agents.

TECHNOLOGY REQUIREMENTS

The technology requirements, depending on the enforcement point (toll gates/gantries or mobile enforcement), are;

Toll Gates / Gantries

- Equipment for automatic vehicle detection (as tri-dimensional scanners, loops, pressure detectors,…);
- DSRC equipment (DSRC *beacon*) to detect / read the OBU;
- Equipment for image capture and license plate recognition (integrated or not);
- System that compares the two license plate numbers obtained.

Mobile enforcement:

- DSRC portable equipment (DSRC *mobile system*) to detect/read the OBU (the detection and reading of the license plate will be visually).

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

In order to constitute evidence of the violation, it should be taken a picture at the moment of the violation (with certified metadata, such as, license plate recognition outcome, location and date of the occurrence) and it should be stored the license plate number recognized by the LPR system installed.
When the vehicle is national, the identification of the OBU's owner must be made by searching the EFC system adherents' database. When the vehicle is a non-national one, the data collected on the violation should be sent to the CI identified on the OBU so that it can initiate the value recovery process.

When the enforcement is made through patrol units, it should be promoted the immediate stopping of the vehicle in the nearest possible site (rest park, gas station, …), the vehicle's driver/owner should be identified at that moment and the situation should be clarified.

TECHNOLOGY REQUIREMENTS

The technology requirements for the evidence constitution of this situation and for the identification of the OBU's owner are:

Evidence constitution:

- DSRC equipment to detect and read the OBU;
- Image capture equipment (this should be certified in what concerns the timestamp and non manipulation of data attached to the photograph);
- Automatic license plate recognition system;
- Database to record the information related with this situation (location and date/time where the vehicle was detected).

Identification of violator :

- Database with information of all adherents of the EFC system, including identification, contacts (phone number, address, …) and vehicle's characteristics (such as license plate number);
- System that searches in this database information about OBU's owner and produces a report to be used in future analyses in case of frequents relapses;
- Privileged communication channels in order to have a high level of information sharing among all EETS actors (considering to use the eNFORCE network resulting from the VERA2 project).

PROCEDURE TO VIOLATION PURSUANCE

The procedure that should be carried through in order to regularize the situation, depends on the nationality of the OBU's owner:

National OBU's owner:

- After the identification of the OBU's owner, he should be contacted (by phone call, letter, ...) in order to clarify the situation and then adopt the correct procedure to regularize it (update the information in the database, use the OBU just in the vehicle with the same license plate number, …)
- In case of the OBU's owner does not make the necessary efforts to regularize the situation, each CI should be free to define what actions should take place (evaluate the possibility of rescind the contract), as well as each TSP/EFCO should be free to interdict the OBU's owner of using the service.
- Create a database to record this type of situations in order to use it in future analyses in case of frequent relapses.
- In case of continued relapse is verified, the owner of the OBU could be subject to a contract rescission, based in the general conditions of the EFC contract (it should be establish between all ETTS actors the inclusion of this clause in the EFC contracts)

Non-National OBU's owner (inside UE):

- Identification of the origin country and the CI of the OBU's owner through the collection of data registered on the OBU;
- Send the information of the verified situation and respective evidences to the CI of the OBU's owner, through a private dedicated european network, that should be eNFORCE network, defined on the scope of VERA2 report, so that it can initiate the process of notification of the OBU's owner to regularize the situation. This process must follow the guiding lines described above for national vehicles.

In the both cases, the situation should be registered in a database and distributed among all EETS actors, in order to collect historical information for future analyses of relapses.

RECOMMENDATIONS

- It should be evaluate the inclusion of a clause in the general conditions of the EFC contract that forbids the user to use the OBU in more that one vehicle, in order to avoid the situation of a different license plate number on the vehicle when compared with the recorded on the OBU.
- The OBU's owner should be obligated to inform the CI when a vehicle's characteristic changes, especially when he buys a new vehicle and intends to use the "old" OBU (when possible).
- It should be considered a fixed and non-removable installation of the OBUs to vehicles, in order to avoid some irregular / violation situations.
- All EFC contracts should have a clause related with the obligation of the vehicle be obligated to circulate with a license plate installed on the correct position, in perfect condition for visual/digital reading and also with an OBU installed inside the vehicle.
- If LPR systems are used for license plate number recognition a minimum level of accuracy for such systems shall be defined in order to minimize manual processing.
- The CI must keep databases to register information concerning the adherents of the EFC system, which allow their identification in case of violations. These databases must regularly be updated and should include information on identification and contacts of the adherents.
- The CI should create and maintain "grey-lists" with information about users that have propensity to violate – the rules for the inclusion of these users in these lists should also be discussed and approved by the state-members and, if necessary, some national legislation should be adapted in order to implement the approved solution.
- The TSP/EFCO/CI should create and maintain "black-lists" with information about users that consistently commit violations or aggravated fraud against the EETS – the rules for the inclusion of these users in the "black-lists" should be discussed and approved by the state-members and, if necessary, some national legislation should be adapted in order to implement the approved solution.
- It should be promoted the use of images for the constitution of evidence of the violations. So, maybe it will be necessary to adapt the national legislation of some state-members in order to implement this recommendation. Some aspects to consider are:
    - The possibility to capture of images from the front-side or from the rear-side or from both sides of the vehicle;
    - The possibility to archive all images or only of the irregular / violation situations;
    - The possibility to record and archive panoramic images of vehicles in situation of violation (and not only those which capture only the licence plate);
    - The possibility to record and archive a panoramic image of the passing vehicle with the recognition of the license plate;
    - The certification of the data attached to the photographs (for example, time and place information);

- Other situation that might be considered.

- It should be promoted the use of a private and dedicated network for communication between the different EETS actors. This network must include systems, applications and templates of documents and procedures so that the sharing of information could be effectively done. In this scope, should be used the eNFORCE network, defined in the VERA2 report.
- A regulatory/certification european agency should be set up to address issues related to legal procedures, relationships between EETS actors, etc..
- The reliability of the EETS is dependent of the fact that all accepted EETS actors comply with a basic set of rules. The acceptance minimum requirements shall be part of a MoU.

6.3.2.1.4 License plate number registered on the Booking System different from the one read

SITUATION	This situation occurs when an incorrect license plate number has been registered on the booking system.

IDENTIFICATION OF THE VIOLATION

MEANS

To identify this situation, it is necessary that, at the toll gate/gantry or check-point, the RSE be able to detect a vehicle passing through and capture an image of the vehicle and to process the license plate number. When comparing the license plate number obtained from the picture, the RSE must check for an entry in the booking database and log a possible violation if no valid and correct entry for this license plate is found.

The enforcement made by mobile units is also supposed to read the information from the license plate (either visually with manual entry by the control agents or automated) and check the central database for a valid booking.

TECHNOLOGY REQUIREMENTS

The technology requirements, depending on the enforcement point (toll gates/gantries or mobile enforcement), are;

Toll Gates / Gantries

- Equipment for automatic vehicle detection (as tri-dimensional scanners, loops, pressure detectors,…);
- Equipment for image capture and license plate recognition (integrated or not);
- System that allows to check for a vlaid booking
-

Mobile enforcement:

- Mobile equipment to check valid booking in database

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

In order to constitute evidence of the violation, it should be taken a picture at the moment of the violation (with certified metadata, such as, license plate recognition outcome, location and date of the occurrence) and it should be stored the license plate number recognized by the LPR system installed.
When the vehicle is national, the identification of the vehicle's owner must be made by searching the EFC system adherents' database. When the vehicle is a non-national one, the data collected on the violation should be sent to the CI identified holding a contract for this vehicle so that it can initiate the value recovery process.
If no CI for the vehicle in question can be identified based on the LPN, national and other authorities assistance is required to identify and charge the user.

When the enforcement is made through patrol units, it should be promoted the immediate stopping of the vehicle in the

nearest possible site (rest park, gas station, …), the vehicle's driver/owner should be identified at that moment and the situation should be clarified.

TECHNOLOGY REQUIREMENTS

The technology requirements for the evidence constitution of this situation and for the identification of the OBU's owner are:

- Image capture equipment (this should be certified in what concerns the timestamp and non manipulation of data attached to the photograph);
- Automatic license plate recognition system;
- Database to record the information related with this situation (location and date/time where the vehicle was detected).
- Mobile equipment to check valid bookings in database for agents

Identification of violator :

- Database with information of all adherents of the EFC system, including identification, contacts (phone number, address, …) and vehicle's characteristics (such as license plate number);
- System that searches in this database information about LPN's owner and produces a report to be used in future analyses in case of frequents relapses;
- Privileged communication channels in order to have a high level of information sharing among all EETS actors (considering to use the eNFORCE network resulting from the VERA2 project or a dedicated network of all EETS CIs and Road/Toll Operators) to identify registered / contracted users based on LPN
- Every passing of a vehicle with a correct, valid booking detected by RSE should lead to "punching the ticket" as used, so that after the validity period of a booking fraudulent claims for return of payment can be detected. In case of a mistake (e.g. typo when booking), the ticket will not be marked as used after end of the validity period, but the passage of the vehicle with the real LPN will have been identified as possible violation by LPR. It is thus possible to check for this using e.g. fuzzy search. In case of fraud, e.g. by using the same ticket for two closely matching LPNs, the double usage can be identified and enforcement action taken.

PROCEDURE TO VIOLATION PURSUANCE

The procedure that should be carried through in order to regularize the situation, depends on the nationality of the LPN's owner:

National License Plate Number (LPN):

- After the identification of the LPN's owner, he should be contacted (by phone call, letter, ...) in order to clarify the situation and then adopt the correct procedure to regularize it (update the information in the database, use the OBU just in the vehicle with the same license plate number, …)
- In case of the OBU's owner does not make the necessary efforts to regularize the situation, each CI should be free to define what actions should take place (evaluate the possibility of rescind the contract), as well as each TSP/EFCO should be free to interdict the OBU's owner of using the service.
- Create a database to record this type of situations in order to use it in future analyses in case of frequent relapses.

- In case of continued relapse is verified, the owner of the OBU could be subject to a contract rescission, based in the general conditions of the EFC contract (it should be establish between all ETTS actors the inclusion of this clause in the EFC contracts)

Non-National LPN owner (inside EU):

- Identification of the origin country and the CI of the LPN's owner through the collection of data registered on the RSE by LPR;
- Send the information of the verified situation and respective evidences to the CI of the LPN's owner, through a private dedicated european network, that should be eNFORCE network, defined on the scope of VERA2 report, so that it can initiate the process of notification of the LPN's owner to regularize the situation. This process must follow the guiding lines described above for national vehicles.
- If no CI can be identified, the case should be handed over to authorities and be treated in accord with VERA2 via eNFORCE.

In the both cases, the situation should be registered in a database and distributed among all EETS actors, in order to collect historical information for future analyses of relapses.

RECOMMENDATIONS

- The CI must keep databases to register information concerning the adherents of the EFC system, which allow their identification in case of violations. These databases must regularly be updated and should include information on identification incldugin LPN and contacts of the adherents.
- The CI should create and maintain "grey-lists" with information about users that have propensity to violate – the rules for the inclusion of these users in these lists should also be discussed and approved by the state-members and, if necessary, some EU and national legislation should be adapted in order to implement the approved solution.
- The TSP/EFCO/CI should create and maintain "black-lists" with information about users that consistently commit violations or aggravated fraud against the EETS – the rules for the inclusion of these users in the "black-lists" should be discussed and approved by the state-members and, if necessary, some national legislation should be adapted in order to implement the approved solution.
- If LPR systems are used for license plate number recognition a minimum level of accuracy for such systems shall be defined in order to minimize manual processing.
- It should be promoted the use of images for the constitution of evidence of the violations. So, maybe it will be necessary to adapt the national legislation of some state-members in order to implement this recommendation. Some aspects to consider are:
    - The possibility to capture of images from the front-side or from the rear-side or from both sides of the vehicle;
    - The possibility to archive at least of the irregular / violation situations;
    - The possibility to record and archive panoramic images of vehicles in situation of violation (and not only those which capture only the licence plate), especially to allow identification of drivers;
    - The possibility to record and archive a panoramic image of the passing vehicle with the recognition of the license plate;
    - The certification of the data attached to the photographs (for example, time and place information);
    - Other situation that might be considered.
- It should be promoted the use of a private and dedicated network for communication between the different EETS actors. This network must include systems, applications and templates of documents and procedures so that the

sharing of information could be effectively done. In this scope, should be used the eNFORCE network, defined in the VERA2 report.

- A regulatory/certification european agency should be set up to address issues related to legal procedures, relationships between EETS actors, etc..
- In this scope, also clear roles of national authorities and procedures for their cooperation in dealing with toll fraud should be established (legal framework, communications & networks, operating procedures & rules).
- The reliability of the EETS is dependent of the fact that all accepted EETS actors comply with a basic set of rules. The acceptance minimum requirements shall be part of a MoU.

6.3.2.1.5 Discrepancy between the declared and the determined parameters that define the vehicle tariff class

SITUATION	This situation takes place when the tariff class's parameters declared on the OBU or in the booking system do not meet the ones determined by the enforcement system (that could be RSE, mobile enforcement or database retrieval).

IDENTIFICATION OF THE VIOLATION

MEANS

To make it possible to identify a situation of discrepancy between declared and determined tariff class, the means to be made available must guarantee the following tasks:

Declared parameters:

- Reading of the parameters that identify the tariff class stored on the OBU (this is only applicable to mandatory parameters under the definition of the EETS);
- Database retrieval of the receipt stored in the booking system including the declared parameters that identify the tariff class (in systems that allow booking).

Determined parameters:

- Measurement, on the basis of the vehicle analysis, the real value of those parameters;
- Database retrieval of fee/toll relevant vehicle data.

Verification:

- Comparison of the determined class and the one declared by the user.

TECHNOLOGY REQUIREMENTS

Based on the necessities identified in the previous paragraph, the recommended technology requirements must be determined depending on the enforcement point: toll gates and multi-lane gantries or patrol-cars in mobile enforcement.

Toll Gates / Multi-lane Gantries:

In this case, the technology requirements that should be guaranteed are:

- DSRC equipment (Microwave- or IR-*beacon)* to read the relevant parameters stored on the OBU;
- Equipment for measuring the parameters that define the tariff class (for example, laser scanners for tri-dimensional analysis, pressure detectors, sensors to measure the height above first axle, …);
- Equipment to communicate to central databases;
- System to compare the information read from the OBU and the one which is determined by the RSE.

Mobile enforcement:

If we consider the enforcement made by the patrol-cars, the technology requirements are:

- DSRC equipment (DSRC *mobile system*) to read the relevant data stored on the OBU;
- The determination of the parameters that identify the tariff class should be made visually by the patrol agents, and, in case of doubt, these agents should be legally competent to stop the car (on the emergency lane or in check points) and verify those parameters by others technical means.
- When possible, make use of databases that store the existent car models and the correspondent class parameters.

- For enforcement agents with executive powers, online access to vehicle registration database is recommended

Evidence Constitution and Violator Identification

Means

The evidence constitution should be carried out through the data collected by electronic means and by digital photograph. This is only applicable to the enforcement that is made in toll gates or in multi-lane gantries. When the enforcement is made through mobile enforcement, the immediate stopping of the car and the regularization on the situation is preferable, thus not being necessary to constitute evidence of the violation.

Considering the enforcement made in the toll gates or in multi-lane gantries, the identification of the violator, in case of dealing with a national citizen, will have to be carried out through the research of information concerning the owner of the vehicle in databases of adherents that the CI should create and maintain and in which should be registered information about the vehicle and contacts of the owner. In case of dealing with a non-national citizen, the CI/TSP/EFCO should collect all the information about the violation and send it to the CI with which the violator has the contract established.

Technology Requirements

Considering what was stated on the paragraph “Means”, the technical requirements to constitute evidence of the violation and identify the violator are only applicable to the enforcement made on the toll gates and multi-lane gantries. In this case, the technology to install should respond to the following needs:

Evidence constitution:

- Image capture equipment (the equipment should be certified in the following capabilities: sensitiveness, accuracy, synchronicity, integrity);
- Systems for automatic license plate recognition;
- Database to collect data related to the violation (time and place information, data read from the OBU, license plate number, …).

Identification of violator:

- Database to collect data related to the adherents of the system, including identification and contacts of the owner of the vehicle (phone number, address, …) and information about the vehicle (for example, license plate number);
- System that searches in this database information about the vehicle and its owner and that correlates this information with the data collected about the violation, producing a violation report to be used as a starting point for the recovery process.

Procedure to Violation Pursuance

The procedure that should be carried through in order to regularize the situation, should be the following, depending on the nationality of the vehicle:

National Vehicles:

- Identification of the violator based on the information read from the OBU and the data registered in the adherents database;
- Notification (via sms, phone call, letter, registered letter, ...) of the violator to inform about the necessity to regularize the situation - this notification can assume different degrees of reliability, as the intended level of insistence (for example, a phone call allows a higher reliability degree than a sms).
- Registry about the violation verified, in order to collect historical data about relapses;
- In case that continued relapse is verified, the owner of the OBU will have to be subject to rescission of the contract, on the basis of its general conditions (for example, after verified x situations of this type);
- In case that the owner of the OBU does not make the necessary efforts to regularize the situation, each country should be free to define what actions should take place.

Non-National Vehicles (inside UE):

- Identification of the origin country of the owner of the OBU through the collection of data registered on the OBU;
- Sending of information (through a private dedicated European network, that should be eNFORCE, defined on the scope of VERA2 report) on the verified situation and respective evidences to the CI with which the contract has been signed so that it can initiate the process of regularization of the situation. This process must follow the guiding lines described above for national vehicles.

RECOMMENDATIONS

- It should be promoted the use of photograph means for constitution of evidence of the violations. In this direction, the legislation in some of the state-members will have to be reviewed so that it could be adapted to this requirement.
- The CI must keep databases to register information concerning the adherent ones that allow their identification in case of verification of irregularities. These databases must regularly be updated and should include information on identification and contacts of the adherent ones.
- It should be defined which entity has the ability to initiate the procedure for the regularization of this kind of situations when the user is a non-national citizen. In this scope, the state members must discuss and define what should be the procedure for the recovery of values in debt by non-national citizens (or the CI with which the contract was signed pays the value in debt to the TSP/EFCO of the country where the violation took place and then solves internally the issue with their adherent or the TSP/EFCO of the country where the violation took place should have the competence of solving the problem directly with the non-national citizen).
- It should be promoted the use of a private and dedicated network for communication between the different EETS actors. This network must include systems, applications and templates of documents and procedures so that the sharing of information could be effectively done. In this scope, should be used the eNFORCE network, defined in the VERA2 report.
- A regulatory/certification European agency should be set up to address issues related to legal procedures, relationships between EETS actors, etc..
- It should be defined procedures for certification of the equipment used on the determination of the parameters of the vehicle class (like cameras, pressure sensors and others).
- Maintenance of OBU (for users with contract) and LP (for users with no contract) black lists by authorized governmental organizations that participate in the eNFORCE network, for initiation of the violation process.
- Online access of control agents with executive powers at least to their national vehicle registration databases should

be established.

- For all vehicles, the legal requirement for the driver to present full vehicle registration documents for inspection should be established in the legal framework of the EU and all other countries joining EETS.

6.3.2.1.6 Number of axles declared on the OBU or in the booking system different from the one determined by enforcement system

SITUATION	This situation takes place when the number of axles declared on the OBU or in the booking system does not meet the one determined by the enforcement system (that could be RSE, mobile enforcement or database retrieval).

IDENTIFICATION OF THE VIOLATION

MEANS

To make it possible to identify a situation of discrepancy between declared and determined tariff class, the means to be made available must guarantee the following tasks:

Declared Number of Axles:

Reading of the number of axles declared on the OBU;

Database retrieval of the receipt stored in the booking system including the declared number of axles (in systems that allow booking).

Determined Number of Axles:

Determination of the real number of axles on the vehicle / combination (laser scanners, pressure sensors or through indirect measurements of height, length, volume and shape of vehicle);

Database retrieval of vehicle's axle configuration.

Verification:

Comparison of the determined number of axles and the one declared by the user.

TECHNOLOGY REQUIREMENTS

Based on the necessities identified in the previous paragraph, the recommended technology requirements must be determined depending on the enforcement point: toll gates and multi-lane gantries or patrol-cars in mobile enforcement and the definition of axle counting an the relevant tolling context.

Toll Gates / Multi-lane Gantries:

In this case, the technology requirements that should be guaranteed are:

- DSRC equipment (DSRC microwave or IR beacon) to read the relevant parameters stored on the OBU;
- Equipment for counting the number of axles mounted on the vehicle or for counting the number of axles touching the ground (for example, laser scanners for tri-dimensional analysis, pressure detectors, cameras and optical pattern recognition, …);
- Equipment to communicate to central databases;
- System to compare the information read from the OBU or declared in the booking and the one which is determined by the RSE.

Mobile enforcement:

If we consider the enforcement made by the patrol-cars, the technology requirements are:

- DSRC equipment (DSRC microwave or IR-system) to read the relevant data stored on the OBU (declaration);

- The axle count should be done visually by the patrol agents, and, in case of doubt, these agents should be legally competent to stop the car (on the emergency lane or in check points) and verify those parameters by other means.
- When possible, make use of databases that store the existent car models and the correspondent axle configurations.
- For enforcement agents with executive powers, online access to vehicle registration database is recommended

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

The evidence constitution should be carried out through the data collected by electronic means and by digital photograph. This is only applicable to the enforcement that is made in toll gates or in multi-lane gantries. When the enforcement is made through mobile enforcement, the immediate stopping of the car and the regularization on the situation is preferable, thus not being necessary to constitute evidence of the violation.

Violation detected at a Toll Gate or a Multi Lane Gantry:

The data collected by the control station (RSE), e.g

- basic parameters measured by laser scanners or any other means of counting number of axles;
- number of axles stored in the OBU
- digital photographs of the vehicle showing the total number of axles of the vehicle
- the digitl photograph of the license plate of the vehicle
- the time stamp and the location of the event

should be signed by a qualified digital signature and stored in a secure local storage medium and transmitted to the enforcement center and again stored in a secure storage medium. The storage medium should be prevented against unauthorized access.

The data collected by the Mobile Patrol Units, e.g

- number of axles stored in the OBU
- number of axles visually counted by the Mobile Patrol Unit
- digital photographs of the vehicle showing the total number of axles of the vehicle
- the digital photograph of the license plate of the vehicle
- the name and personal number of the Patrol Unit Agent which detected the violation
- the time stamp and the location of the event

should be signed by a qualified digital signature and stored in a secure local storage medium and transmitted to the enforcement center and again stored in a secure storage medium. The storage medium should be prevented against unauthorized access.

Considering the enforcement made in the toll gates or in multi-lane gantries, the identification of the violator, in case of dealing with a national citizen, will have to be carried out through the research of information concerning the owner of the vehicle in databases of adherents that the CI should create and maintain and in which should be registered information about the vehicle and contacts of the owner. In case of dealing with a non-national citizen, the CI/TSP/EFCO should collect all the information about the violation and send it to the CI with which the violator has the contract established.
If no CI for a certain vehicle (=LPN) can be found, the national and other authorities should be handling identification and charging the user, e.g. according to VERA2.

TECHNOLOGY REQUIREMENTS

Considering what was stated on the paragraph "Means", the technical requirements to constitute evidence of the violation and identify the violator are only applicable to the enforcement made on the toll gates and multi-lane gantries. In this case, the technology to install should respond to the following needs:

Evidence constitution:

- Image capture equipment (the equipment should be certified in the following capabilities: sensitiveness, accuracy, synchronicity, integrity);
- Systems for automatic license plate recognition;
- Systems for axle counting (Laser Scanners, Pressure Sensors where appropriate, cameras and optical pattern recognition where appropriate)
- Database to collect data related to the violation (time and place information, data read from the OBU, license plate number, …).

Identification of violator:

- Database to collect data related to the adherents of the system, including identification and contacts of the owner of the vehicle (phone number, address, …) and information about the vehicle (for example, license plate number);
- System that searches in this database information about the vehicle and its owner and that correlates this information with the data collected about the violation, producing a violation report to be used as a starting point for the recovery process.

PROCEDURE TO VIOLATION PURSUANCE

The procedure that should be carried through in order to regularize the situation, should be the following, depending on the nationality of the vehicle:

National Vehicles:

- Identification of the violator based on the information read from the OBU and the data registered in the adherents database;
- Notification (via sms, phone call, letter, registered letter, ...) of the violator to inform about the necessity to regularize the situation - this notification can assume different degrees of reliability, as the intended level of insistence (for example, a phone call allows a higher reliability degree than a sms).
- Registry about the violation verified, in order to collect historical data about relapses;
- In case that continued relapse is verified, the owner of the OBU will have to be subject to rescission of the contract, on the basis of its general conditions (for example, after verified x situations of this type);
- In case that the owner of the OBU does not make the necessary efforts to regularize the situation, each country should be free to define what actions should take place.

Non-National Vehicles (inside UE):

- Identification of the origin country of the owner of the OBU through the collection of data registered on the OBU;
- Sending of information (through a private dedicated European network, that should be eNFORCE, defined on the

scope of VERA2 report) on the verified situation and respective evidences to the CI with which the contract has been signed so that it can initiate the process of regularization of the situation. This process must follow the guiding lines described above for national vehicles.

RECOMMENDATIONS

- Secure digital photograph should be promoted for constitution of evidence of the violations. The digital photograph should be secured by a qualified digital signature. In this direction, the legislation in some of the state-members will have to be reviewed so that it could be adapted to this requirement.
- The CI must keep databases concerning the adherents in order to identify them in case of verification of irregularities. These databases must be kept updated and should include information on identification and contacts of the adherent ones.
- It should be defined which entity has the ability to initiate the procedure for pursuance of the violations when the user is a non-national citizen. In this scope, the state members must discuss and define what should be the procedure for the recovery of values in debt (toll fee and/or fine due to violation) by non-national citizens e.g.:
    - the CI with which the contract was signed pays the value in debt to the TSP/EFCO of the country where the violation took place and then solves internally the issue with their adherent
    - or the TSP/EFCO of the country where the violation took place should have the competence of solving the problem directly with the non-national citizen).
- It should be promoted the use of a private and dedicated network for communication between the different EETS actors. This network must include systems, applications and templates of documents and procedures so that the sharing of information could be effectively done. In this scope, the eNFORCE network, defined in the VERA2 report, should be used.
- A regulatory/certification European agency should be set up to address issues related to legal procedures, relationships between EETS actors, etc. .
- Procedures for certification of the equipment used in the determination of the parameters of the vehicle class (like cameras, pressure sensors and others) must be defined.
- Online access to national vehicle registration databases for enforcement agents with executive power.

6.3.2.1.7 (Legal maximum laden) Weight of the tractor unit declared on the OBU or in the booking system different from the one determined by the enforcement system

SITUATION	This situation takes place when legal maximum laden weight declared on the OBU or in the booking system do not meet the one determined by the enforcement system. The regularities regarding the obligation to pay depending on the maximum laden weight (MLW) can be different in the tolling systems, e.g. MLW of pulling vehicle, MLW of combination.

IDENTIFICATION OF THE VIOLATION

MEANS

It has to be stated that the maximum laden weight is a figure which can only be measured automatically as an approximation. The quality of the classification result depends strongly on the weight and type of vehicles which are object for tolling. [Heavy goods vehicles do have other vehicle characteristics than 3.5. t vehicles, so the decision mechanism and criteria are different for this example.]

To make it possible to identify a situation of discrepancy between declared and determined legal maximum laden weight, the means to be made available must guarantee the following tasks:

Declared legal maximum laden weight:

- Reading of the legal maximum laden weight declared on the OBU;
- Database retrieval of the receipt stored in the booking system including the declared legal maximum laden weight (in systems that allow booking).

Determined legal maximum laden weight:

- Identification of the type of vehicle and look-up of typical parameters for this type;
- Check of actual weight (e.g. measured by pressure sensors) against declared value (if actual weight is larger htan declared value, than it is either a toll violation [wrong legal max weight declared] or a traffic violation [actual weight larger than legal max weight])
- Database retrieval of vehicle's legal maximum laden weight
  - From CIs databases
  - From national or other vehicle registration databases – at least for suspect cases and possibly through authorities.
- In case of mobile enforcement: Stopping vehicle and checking registration documents in case of doubt

Verification:

- Comparison of the determined legal maximum laden weight and the one declared by the user.

TECHNOLOGY REQUIREMENTS

Based on the necessities identified in the previous paragraph, the recommended technology requirements must be determined depending on the enforcement point: toll gates and multi-lane gantries or patrol-cars in mobile enforcement and the definition of axle counting an the relevant tolling context.

Toll Gates / Multi-lane Gantries:

In this case, the technology requirements that should be guaranteed are:

- Equipment for identifying vehicle model and configuration or for measuring the actual weight of the vehicle (for example, laser scanners as well as cameras and optical pattern recognition to identify vehicle model and configuration for the first, pressure detectors for the latter, , …);
- Equipment to communicate to central databases;
- System to compare the information read from the OBU or declared in the booking and the one which is determined by the RSE.

Mobile enforcement:

If we consider the enforcement made by the patrol-cars, the technology requirements are:

- DSRC equipment (DSRC *mobile system*) to read the relevant data stored on the OBU;
- The vehicle model and configuration identification should be done visually by the patrol agents, and, in case of doubt, these agents should be legally competent to stop the car (on the emergency lane or in check points) and verify those parameters by other means.
- When possible, make use of databases that store the existent car models and the correspondent configurations.
- For enforcement agents with executive powers, online access to vehicle registration database is recommended

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

The evidence constitution should be carried out through the data collected by electronic means and by digital photograph. This is only applicable to the enforcement that is made in toll gates or in multi-lane gantries. When the enforcement is made through mobile enforcement, the immediate stopping of the car and the regularization on the situation is preferable, thus not being necessary to constitute evidence of the violation.

Considering the enforcement made in the toll gates or in multi-lane gantries, the identification of the violator, in case of dealing with a national citizen, will have to be carried out through the research of information concerning the owner of the vehicle in databases of adherents that the CI should create and maintain and in which should be registered information about the vehicle and contacts of the owner. In case of dealing with a non-national citizen, the CI/TSP/EFCO should collect all the information about the violation and send it to the CI with which the violator has the contract established.

If no CI for a certain vehicle (=LPN) can be found, the national and other authorities should be handling identification and charging the user, e.g. according to VERA2.

TECHNOLOGY REQUIREMENTS

Considering what was stated on the paragraph “Means”, the technical requirements to constitute evidence of the violation and identify the violator are only applicable to the enforcement made on the toll gates and multi-lane gantries. In this case, the technology to install should respond to the following needs:

Evidence constitution:

- Image capture equipment (the equipment should be certified in the following capabilities: sensitiveness, accuracy, synchronicity, integrity);
- Systems for automatic license plate recognition;
- Systems for determining vehicle model and configuration and/or actual weight (Laser Scanners, Pressure Sensors where appropriate, cameras and optical pattern recognition where appropriate)
- Database to collect data related to the violation (time and place information, data read from the OBU, license plate number, …).

Identification of violator:

- Database to collect data related to the adherents of the system, including identification and contacts of the owner of the vehicle (phone number, address, …) and information about the vehicle (for example, license plate number);
- System that searches in this database information about the vehicle and its owner and that correlates this information with the data collected about the violation, producing a violation report to be used as a starting point for the recovery process.

PROCEDURE TO VIOLATION PURSUANCE

The procedure that should be carried through in order to regularize the situation, should be the following, depending on the nationality of the vehicle:

National Vehicles:

- Identification of the violator based on the information read from the OBU and the data registered in the adherents database;
- Notification (via sms, phone call, letter, registered letter, ...) of the violator to inform about the necessity to regularize the situation - this notification can assume different degrees of reliability, as the intended level of insistence (for example, a phone call allows a higher reliability degree than a sms).
- Registry about the violation verified, in order to collect historical data about relapses;
- In case that continued relapse is verified, the owner of the OBU will have to be subject to rescission of the contract, on the basis of its general conditions (for example, after verified x situations of this type);
- In case that the owner of the OBU does not make the necessary efforts to regularize the situation, each country should be free to define what actions should take place.

Non-National Vehicles (inside UE):

- Identification of the origin country of the owner of the OBU through the collection of data registered on the OBU;
- Sending of information (through a private dedicated European network, that should be eNFORCE, defined on the scope of VERA2 report) on the verified situation and respective evidences to the CI with which the contract has been signed so that it can initiate the process of regularization of the situation. This process must follow the guiding lines described above for national vehicles.

RECOMMENDATIONS

- It should be promoted the use of photograph means for constitution of evidence of the violations. In this direction, the

legislation in some of the state-members will have to be reviewed so that it could be adapted to this requirement.

- The CI must keep databases to register information concerning the adherent ones that allow their identification in case of verification of irregularities. These databases must regularly be updated and should include information on identification and contacts of the adherent ones.
- It should be defined which entity has the ability to initiate the procedure for the regularization of this kind of situations when the user is a non-national citizen. In this scope, the state members must discuss and define what should be the procedure for the recovery of values in debt by non-national citizens (or the CI with which the contract was signed pays the value in debt to the TSP/EFCO of the country where the violation took place and then solves internally the issue with their adherent or the TSP/EFCO of the country where the violation took place should have the competence of solving the problem directly with the non-national citizen).
- It should be promoted the use of a private and dedicated network for communication between the different EETS actors. This network must include systems, applications and templates of documents and procedures so that the sharing of information could be effectively done. In this scope, should be used the eNFORCE network, defined in the VERA2 report.
- A regulatory/certification European agency should be set up to address issues related to legal procedures, relationships between EETS actors, etc..
- It should be defined procedures for certification of the equipment used on the determination of the parameters of the vehicle class (like cameras, pressure sensors and others).
- Maintenance of OBU (for users with contract) and LP (for users with no contract) black lists by authorized governmental organizations that participate in the eNFORCE network, for initiation of the violation process.
- Online access of control agents with executive powers at least to their national vehicle registration databases should be established.
- For all vehicles, the legal requirement for the driver to present full vehicle registration documents for inspection should be established in the legal framework of the EU and all other countries joining EETS.

6.3.2.1.8 (Legal maximum laden) Weight of the trailer declared on the OBU or in the booking system different from the one determined by the enforcement system

SITUATION	This situation takes place when legal maximum laden weight declared on the OBU or in the booking system do not meet the one determined by the enforcement system.

IDENTIFICATION OF THE VIOLATION

MEANS

It has to be stated that the maximum laden weight is a figure which can only be measured automatically as an approximation. The quality of the classification result depends strongly on the weight and type of vehicles which are object for tolling. [Heavy goods vehicles do have other vehicle characteristics than 3.5. t vehicles, so the decision mechanism and criteria are different for this example.]

To make it possible to identify a situation of discrepancy between declared and determined legal maximum laden weight, the means to be made available must guarantee the following tasks:

Declared legal maximum laden weight:

- Reading of the legal maximum laden weight declared on the OBU;
- Database retrieval of the receipt stored in the booking system including the declared legal maximum laden weight (in systems that allow booking).

Determined legal maximum laden weight:

- Identification of the type of vehicle and look-up of typical parameters for this type;
- Check of actual weight (e.g. measured by pressure sensors) against declared value (if actual weight is larger htan declared value, than it is either a toll violation [wrong legal max weight declared] or a traffic violation [actual weight larger than legal max weight])
- Database retrieval of vehicle's legal maximum laden weight
- From CIs databases
- From national or other vehicle registration databases – at least for suspect cases and possibly through authorities.
- In case of mobile enforcement: Stopping vehicle and checking registration documents in case of doubt

Verification:

- Comparison of the determined legal maximum laden weight and the one declared by the user.

TECHNOLOGY REQUIREMENTS

Based on the necessities identified in the previous paragraph, the recommended technology requirements must be determined depending on the enforcement point: toll gates and multi-lane gantries or patrol-cars in mobile enforcement and the definition of axle counting an the relevant tolling context.

Toll Gates / Multi-lane Gantries:

In this case, the technology requirements that should be guaranteed are:

- Equipment for identifying vehicle model and configuration or for measuring the actual weight of the vehicle (for example, laser scanners as well as cameras and optical pattern recognition to identify vehicle model and configuration for the first, pressure detectors for the latter, , …);
- Equipment to communicate to central databases;
- System to compare the information read from the OBU or declared in the booking and the one which is determined by the RSE.

Mobile enforcement:

If we consider the enforcement made by the patrol-cars, the technology requirements are:

- DSRC equipment (DSRC *mobile system*) to read the relevant data stored on the OBU;
- The vehicle model and configuration identification should be done visually by the patrol agents, and, in case of doubt, these agents should be legally competent to stop the car (on the emergency lane or in check points) and verify those parameters by other means.
- When possible, make use of databases that store the existent car models and the correspondent configurations.
- For enforcement agents with executive powers, online access to vehicle registration database is recommended

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

The evidence constitution should be carried out through the data collected by electronic means and by digital photograph. This is only applicable to the enforcement that is made in toll gates or in multi-lane gantries. When the enforcement is made through mobile enforcement, the immediate stopping of the car and the regularization on the situation is preferable, thus not being necessary to constitute evidence of the violation.

Considering the enforcement made in the toll gates or in multi-lane gantries, the identification of the violator, in case of dealing with a national citizen, will have to be carried out through the research of information concerning the owner of the vehicle in databases of adherents that the CI should create and maintain and in which should be registered information about the vehicle and contacts of the owner. In case of dealing with a non-national citizen, the CI/TSP/EFCO should collect all the information about the violation and send it to the CI with which the violator has the contract established.

If no CI for a certain vehicle (=LPN) can be found, the national and other authorities should be handling identification and charging the user, e.g. according to VERA2.

TECHNOLOGY REQUIREMENTS

Considering what was stated on the paragraph “Means”, the technical requirements to constitute evidence of the violation and identify the violator are only applicable to the enforcement made on the toll gates and multi-lane gantries. In this case, the technology to install should respond to the following needs:

Evidence constitution:

- Image capture equipment (the equipment should be certified in the following capabilities: sensitiveness, accuracy, synchronicity, integrity);
- Systems for automatic license plate recognition;

- Systems for determining vehicle model and configuration and/or actual weight (Laser Scanners, Pressure Sensors where appropriate, cameras and optical pattern recognition where appropriate)
- Database to collect data related to the violation (time and place information, data read from the OBU, license plate number, …).

Identification of violator:

- Database to collect data related to the adherents of the system, including identification and contacts of the owner of the vehicle (phone number, address, …) and information about the vehicle (for example, license plate number);
- System that searches in this database information about the vehicle and its owner and that correlates this information with the data collected about the violation, producing a violation report to be used as a starting point for the recovery process.

PROCEDURE TO VIOLATION PURSUANCE

The procedure that should be carried through in order to regularize the situation, should be the following, depending on the nationality of the vehicle:

National Vehicles:

- Identification of the violator based on the information read from the OBU and the data registered in the adherents database;
- Notification (via sms, phone call, letter, registered letter, ...) of the violator to inform about the necessity to regularize the situation - this notification can assume different degrees of reliability, as the intended level of insistence (for example, a phone call allows a higher reliability degree than a sms).
- Registry about the violation verified, in order to collect historical data about relapses;
- In case that continued relapse is verified, the owner of the OBU will have to be subject to rescission of the contract, on the basis of its general conditions (for example, after verified x situations of this type);
- In case that the owner of the OBU does not make the necessary efforts to regularize the situation, each country should be free to define what actions should take place.

Non-National Vehicles (inside UE):

- Identification of the origin country of the owner of the OBU through the collection of data registered on the OBU;
- Sending of information (through a private dedicated European network, that should be eNFORCE, defined on the scope of VERA2 report) on the verified situation and respective evidences to the CI with which the contract has been signed so that it can initiate the process of regularization of the situation. This process must follow the guiding lines described above for national vehicles.

RECOMMENDATIONS

- It should be promoted the use of photograph means for constitution of evidence of the violations. In this direction, the legislation in some of the state-members will have to be reviewed so that it could be adapted to this requirement.
- The CI must keep databases to register information concerning the adherent ones that allow their identification in case of verification of irregularities. These databases must regularly be updated and should include information on

identification and contacts of the adherent ones.

- It should be defined which entity has the ability to initiate the procedure for the regularization of this kind of situations when the user is a non-national citizen. In this scope, the state members must discuss and define what should be the procedure for the recovery of values in debt by non-national citizens (or the CI with which the contract was signed pays the value in debt to the TSP/EFCO of the country where the violation took place and then solves internally the issue with their adherent or the TSP/EFCO of the country where the violation took place should have the competence of solving the problem directly with the non-national citizen).
- It should be promoted the use of a private and dedicated network for communication between the different EETS actors. This network must include systems, applications and templates of documents and procedures so that the sharing of information could be effectively done. In this scope, should be used the eNFORCE network, defined in the VERA2 report.
- A regulatory/certification European agency should be set up to address issues related to legal procedures, relationships between EETS actors, etc..
- It should be defined procedures for certification of the equipment used on the determination of the parameters of the vehicle class (like cameras, pressure sensors and others).
- Maintenance of OBU (for users with contract) and LP (for users with no contract) black lists by authorized governmental organizations that participate in the eNFORCE network, for initiation of the violation process.
- Online access of control agents with executive powers at least to their national vehicle registration databases should be established.
- For all vehicles, the legal requirement for the driver to present full vehicle registration documents for inspection should be established in the legal framework of the EU and all other countries joining EETS.

6.3.2.1.9 (Legal maximum laden) Weight of the combination (tractor and trailer) declared on the OBU or in the booking system different from the one determined by the enforcement system

SITUATION	This situation takes place when legal maximum laden weight declared on the OBU or in the booking system do not meet the one determined by the enforcement system.

IDENTIFICATION OF THE VIOLATION

MEANS

It has to be stated that the maximum laden weight is a figure which can only be measured automatically as an approximation. The quality of the classification result depends strongly on the weight and type of vehicles which are object for tolling. [Heavy goods vehicles do have other vehicle characteristics than 3.5. t vehicles, so the decision mechanism and criteria are different for this example.]

To make it possible to identify a situation of discrepancy between declared and determined legal maximum laden weight, the means to be made available must guarantee the following tasks:

Declared legal maximum laden weight:

- Reading of the legal maximum laden weight declared on the OBU;
- Database retrieval of the receipt stored in the booking system including the declared legal maximum laden weight (in systems that allow booking).

Determined legal maximum laden weight:

- Identification of the type of vehicle and look-up of typical parameters for this type;
- Check of actual weight (e.g. measured by pressure sensors) against declared value (if actual weight is larger htan declared value, than it is either a toll violation [wrong legal max weight declared] or a traffic violation [actual weight larger than legal max weight])
- Database retrieval of vehicle's legal maximum laden weight
  - From CIs databases
  - From national or other vehicle registration databases – at least for suspect cases and possibly through authorities.
- In case of mobile enforcement: Stopping vehicle and checking registration documents in case of doubt

Verification:

- Comparison of the determined legal maximum laden weight and the one declared by the user.

TECHNOLOGY REQUIREMENTS

Based on the necessities identified in the previous paragraph, the recommended technology requirements must be determined depending on the enforcement point: toll gates and multi-lane gantries or patrol-cars in mobile enforcement and the definition of axle counting an the relevant tolling context.

Toll Gates / Multi-lane Gantries:

In this case, the technology requirements that should be guaranteed are:

- Equipment for identifying vehicle model and configuration or for measuring the actual weight of the vehicle (for example, laser scanners as well as cameras and optical pattern recognition to identify vehicle model and configuration for the first, pressure detectors for the latter, , …);
- Equipment to communicate to central databases;
- System to compare the information read from the OBU or declared in the booking and the one which is determined by the RSE.

Mobile enforcement:

If we consider the enforcement made by the patrol-cars, the technology requirements are:

- DSRC equipment (DSRC *mobile system*) to read the relevant data stored on the OBU;
- The vehicle model and configuration identification should be done visually by the patrol agents, and, in case of doubt, these agents should be legally competent to stop the car (on the emergency lane or in check points) and verify those parameters by other means.
- When possible, make use of databases that store the existent car models and the correspondent configurations.
- For enforcement agents with executive powers, online access to vehicle registration database is recommended

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

The evidence constitution should be carried out through the data collected by electronic means and by digital photograph. This is only applicable to the enforcement that is made in toll gates or in multi-lane gantries. When the enforcement is made through mobile enforcement, the immediate stopping of the car and the regularization on the situation is preferable, thus not being necessary to constitute evidence of the violation.

Considering the enforcement made in the toll gates or in multi-lane gantries, the identification of the violator, in case of dealing with a national citizen, will have to be carried out through the research of information concerning the owner of the vehicle in databases of adherents that the CI should create and maintain and in which should be registered information about the vehicle and contacts of the owner. In case of dealing with a non-national citizen, the CI/TSP/EFCO should collect all the information about the violation and send it to the CI with which the violator has the contract established.

If no CI for a certain vehicle (=LPN) can be found, the national and other authorities should be handling identification and charging the user, e.g. according to VERA2.

TECHNOLOGY REQUIREMENTS

Considering what was stated on the paragraph “Means”, the technical requirements to constitute evidence of the violation and identify the violator are only applicable to the enforcement made on the toll gates and multi-lane gantries. In this case, the technology to install should respond to the following needs:

Evidence constitution:

- Image capture equipment (the equipment should be certified in the following capabilities: sensitiveness, accuracy, synchronicity, integrity);

- Systems for automatic license plate recognition;
- Systems for determining vehicle model and configuration and/or actual weight (Laser Scanners, Pressure Sensors where appropriate, cameras and optical pattern recognition where appropriate)
- Database to collect data related to the violation (time and place information, data read from the OBU, license plate number, …).

Identification of violator:

- Database to collect data related to the adherents of the system, including identification and contacts of the owner of the vehicle (phone number, address, …) and information about the vehicle (for example, license plate number);
- System that searches in this database information about the vehicle and its owner and that correlates this information with the data collected about the violation, producing a violation report to be used as a starting point for the recovery process.

PROCEDURE TO VIOLATION PURSUANCE

The procedure that should be carried through in order to regularize the situation, should be the following, depending on the nationality of the vehicle:

National Vehicles:

- Identification of the violator based on the information read from the OBU and the data registered in the adherents database;
- Notification (via sms, phone call, letter, registered letter, ...) of the violator to inform about the necessity to regularize the situation - this notification can assume different degrees of reliability, as the intended level of insistence (for example, a phone call allows a higher reliability degree than a sms).
- Registry about the violation verified, in order to collect historical data about relapses;
- In case that continued relapse is verified, the owner of the OBU will have to be subject to rescission of the contract, on the basis of its general conditions (for example, after verified x situations of this type);
- In case that the owner of the OBU does not make the necessary efforts to regularize the situation, each country should be free to define what actions should take place.

Non-National Vehicles (inside UE):

- Identification of the origin country of the owner of the OBU through the collection of data registered on the OBU;
- Sending of information (through a private dedicated European network, that should be eNFORCE, defined on the scope of VERA2 report) on the verified situation and respective evidences to the CI with which the contract has been signed so that it can initiate the process of regularization of the situation. This process must follow the guiding lines described above for national vehicles.

RECOMMENDATIONS

- It should be promoted the use of photograph means for constitution of evidence of the violations. In this direction, the legislation in some of the state-members will have to be reviewed so that it could be adapted to this requirement.
- The CI must keep databases to register information concerning the adherent ones that allow their identification in

case of verification of irregularities. These databases must regularly be updated and should include information on identification and contacts of the adherent ones.

- It should be defined which entity has the ability to initiate the procedure for the regularization of this kind of situations when the user is a non-national citizen. In this scope, the state members must discuss and define what should be the procedure for the recovery of values in debt by non-national citizens (or the CI with which the contract was signed pays the value in debt to the TSP/EFCO of the country where the violation took place and then solves internally the issue with their adherent or the TSP/EFCO of the country where the violation took place should have the competence of solving the problem directly with the non-national citizen).
- It should be promoted the use of a private and dedicated network for communication between the different EETS actors. This network must include systems, applications and templates of documents and procedures so that the sharing of information could be effectively done. In this scope, should be used the eNFORCE network, defined in the VERA2 report.
- A regulatory/certification European agency should be set up to address issues related to legal procedures, relationships between EETS actors, etc..
- It should be defined procedures for certification of the equipment used on the determination of the parameters of the vehicle class (like cameras, pressure sensors and others).
- Maintenance of OBU (for users with contract) and LP (for users with no contract) black lists by authorized governmental organizations that participate in the eNFORCE network, for initiation of the violation process.
- Online access of control agents with executive powers at least to their national vehicle registration databases should be established.
- For all vehicles, the legal requirement for the driver to present full vehicle registration documents for inspection should be established in the legal framework of the EU and all other countries joining EETS.

6.3.2.1.10 Type of suspension is different from the one registered in the OBU or in the booking system

SITUATION	This situation occurs when the type of suspension of the vehicle is not the one registered on the OBU. (Suspension means here the springs and the shock absorber system of the vehicle. The reason is that it has a relevant impact on the wear of the surface of the road.).

IDENTIFICATION OF THE VIOLATION

MEANS

The suspension is an integral part of the vehicle and part of the registration parameters of the licensing of the vehicle. As such it has to be stored in the vehicle specific characteristic EFC-attributes (EN/ISO 14906 section 8, attributeID = 22, 4 octet long) in the OBU or has to be declared accordingly in the booking system.

At each control station the RSE reads the OBE after initialization of the communication link and requests the EFC attributes for this specific vehicle which includes in the EFC- attributes (EN/ISO 14906 section 8, attributeID=22) the suspension characteristic.

Toll Gates / Multi-lane Gantries:

As there is no possibility to directly measure the suspension characteristic of a moving vehicle on the road, the control station can not directly detect the real suspension of the controlled vehicle. Moreover it is not possible to compare the registered suspension in the OBE with any parameter, because such a parameter close related to the suspension is not available.

To make it possible to identify a situation of discrepancy between declared and determined suspension type, the means to be made available must guarantee the following tasks:

Declared suspension type:

- Reading of the suspension type declared on the OBU;
- Database retrieval of the receipt stored in the booking system including the declared suspension type (in systems that allow booking).

Determined suspension type:

- Identification of the model and type of vehicle and look-up of typical suspension parameters for this type;
- Database retrieval of vehicle's suspension type
- From CIs databases
- From national or other vehicle registration databases – at least for suspect cases and possibly through authorities.
- In case of mobile enforcement: Stopping vehicle and checking registration documents in case of doubt

Verification:

- Comparison of the determined fuel type and the one declared by the user.

Mobile enforcement:

The only way of detecting the suspension of a vehicle at the time being is the physical inspection of the vehicle by Mobile Enforcement. (But this physical inspection requires training in recognition of the appearance of the classified suspension types.)

If enforcement made by the Mobile Enforcement Officers (MEO) based on obeying free flowing traffic is applied, the technology requirements are:

DSRC equipment (DSRC microwave or IR-system) to read the suspension characteristic stored in the vehicle attributes in the OBE (by declaration);

Visually inspect the vehicle by the MEO, and recognize the suspension characteristic (by comparing the type of vehicle, year of manufacture, etc with a data base containing the suspension characteristics of most vehicles). The MEO should take one or more digital pictures showing some details of suspension and including the license plate for perpetuation of evidence and the MEO should be legally legitimated to stop the car (on the emergency lane or in check points) and initiate the enforcement procedure.

TECHNOLOGY REQUIREMENTS

Toll Gates / Multi-lane Gantries:

For the time being no automatic recognition of suspension is available. Due to this restriction at automated control station no recognition of the suspension of the vehicles is possible. So here the only possibility for enforcement is checking central databases after receiving the license plate number by an ALPR-system.

Mobile enforcement:

Therefore the recognition has to be based on manual inspection by Mobile Enforcement Officers which are trained in such recognition and has enough experience. The technology requirements are:

DSRC equipment (DSRC microwave or IR-system) to read the suspension characteristic stored in the vehicle attributes in the OBE (by declaration);

Visually inspect the vehicle by the MEO, and recognize the suspension characteristic (by comparing the type of vehicle, year of manufacture, etc with a data base containing the suspension characteristics of most vehicles). The MEO should take one or more digital pictures showing some details of suspension and including the license plate for perpetuation of evidence.

The MEO should be legally legitimated to stop the car (on the emergency lane or in check points) and initiate the enforcement procedure.

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

The evidence constitution should be performed by the MEO as only he could manually recognize and classify the suspension.

Mobile enforcement:

The data collected by the MEO in the mobile enforcement vehicle e.g.

- The suspension stored in the OBU
- The suspension recognized by the MEO by visually inspecting the vehicle
- the digital photographs of the vehicle showing significant details of the suspension of the vehicle
- the digital photograph of the license plate of the vehicle
- the name and personal number of the MEO which detected the violation
- the time stamp and the location of the event

should be signed by a qualified digital signature and stored in a secure local storage medium in the mobile enforcement equipment and transmitted to the manually enforcement center and again stored in a secure storage medium. Both storage mediums should be prevented against unauthorized access.

TECHNOLOGY REQUIREMENTS

PROCEDURE TO VIOLATION PERSUANCE

The procedure that should be performed in order to remedy the situation, should be the following, depending on the nationality of the vehicle:

National Vehicles:

- Identification of the violator based on the information read from the OBU and the data registered in the adherents database;
- Notification (via SMS, phone call, letter, registered letter, e-mail,...) of the violator to inform him about the necessity to remedy the violation. The available notifications includes different degrees of reliable service access, for example, a phone call is a more reliable service than a SMS.
- Registration of the verified violation, in order to collect historical data about relapses;
- In case that repeated relapse is verified, the owner of the OBU will have to be subject to rescission of the contract, on the basis of its general conditions (for example, after a number of verified violations of this type);
- In case that the owner of the OBU does not make the necessary efforts to wind up the violations, each country should be free to define what actions should take place.

Non-National Vehicles (inside EU):

- Identification of the origin country of the owner of the OBU by evaluation of data registered on the OBU;
- Transmission of data concerning (through a private dedicated European network, that should be eNFORCE, defined on the scope of VERA2 report or a similar network) the evidences of violations to the CI of the contract provider in order he can initiate the process of pursuing the claims of fees and fines. This process must follow the guidelines described above for national vehicles.

RECOMMENDATIONS

Due to the fact that the suspension could not be recognized automatically by some technical means, the only possibility to detect violations is by visually inspection of the vehicle by the MEO.

In order to perform the detection of violations by the MEOs in a reliable manner the following qualifications and conditions should be fulfilled:

- As the suspension is an integral part of the vehicle the recognition of the suspension characteristic should be performed by trained MEOs which can recognize the suspension by construction details of the vehicle.
- The Mobile Enforcement Car should take along a data base containing most of the types of vehicles, the year of manufacture and the used suspension. The data base could enhance the reliability of the recognition of suspension of different vehicles.
- Secure digital photograph should be promoted for constitution of evidence of the violations. The digital photograph should be secured by a qualified digital signature. In this direction, the legislation in some of the state-members will have to be reviewed so that it could be adapted to this requirement.
- The CI must keep databases concerning the adherents in order to identify them in case of verification of irregularities. These databases must be kept actual in real time and should include information on identification and contacts of the adherent ones.
- It should be defined which entity has the ability to initiate the procedure for pursuance of the violations when the user is a non-national citizen. In this scope, the state members must discuss and define what should be the procedure for the recovery of values in debt (toll fee and/or fine due to violation) by non-national citizens e.g.:
    - the CI with which the contract was signed pays the value in debt to the TSP/EFCO of the country where the violation took place and then solves internally the issue with their adherent
    - or the TSP/EFCO of the country where the violation took place should have the competence of solving the problem directly with the non-national citizen).
- It should be promoted the use of a private dedicated network for communication between the different EETS actors. This network must include systems, applications and templates of documents and procedures so that the information could be shared effectively. In this scope the eNFORCE network, defined in the VERA2 report, should be used.
- A regulatory/certification European agency should be set up to address issues related to legal procedures, relationships between EETS actors, etc..
- It should be defined procedures for certification of the equipment used on the measurement of the parameters of the vehicle class (like cameras, pressure sensors and others).

6.3.2.1.11 Type of fuel is different from the one registered in the OBU or in the booking system

SITUATION	This situation takes place if fuel type declared on the OBU or in the booking system does not meet the one determined by the enforcement system (that could be RSE, mobile enforcement or database retrieval) or if a vehicle that is eligible to toll based on fuel type does not pay toll. (Remark: This is being discussed in some new national schemes, e.g. that only diesel driven trucks will be eligible both to tolling as well as to fuel tax refund, but not trucks driven by other fuels or means).

IDENTIFICATION OF THE VIOLATION

MEANS

To make it possible to identify a situation of discrepancy between declared and determined fuel type, the means to be made available must guarantee the following tasks:

Declared fuel type:

- Reading of the fuel type declared on the OBU;
- Database retrieval of the receipt stored in the booking system including the declared fuel type (in systems that allow booking).

Determined fuel type:

- Identification of the model and type of vehicle and look-up of typical fuel parameters for this type;
- Database retrieval of vehicle's fuel type
  - From CIs databases
  - From national or other vehicle registration databases – at least for suspect cases and possibly through authorities.
- In case of mobile enforcement: Stopping vehicle and checking registration documents in case of doubt

Verification:

- Comparison of the determined fuel type and the one declared by the user.

TECHNOLOGY REQUIREMENTS

Based on the necessities identified in the previous paragraph, the recommended technology requirements must be determined depending on the enforcement point: toll gates and multi-lane gantries or patrol-cars in mobile enforcement and the definition of axle counting an the relevant tolling context.

Toll Gates / Multi-lane Gantries:

In this case, the technology requirements that should be guaranteed are:

- Equipment for identifying vehicle model and configuration (for example, cameras and optical pattern recognition to identify vehicle model and configuration, , …);
- Equipment to communicate to central databases;
- System to compare the information read from the OBU or declared in the booking and the one which is measured by the RSE.

Mobile enforcement:

If we consider the enforcement made by the patrol-cars, the technology requirements are:

- DSRC equipment (DSRC *mobile system*) to read the relevant data stored on the OBU;
- The vehicle model and configuration identification should be done visually by the patrol agents, and, in case of doubt, these agents should be legally competent to stop the car (on the emergency lane or in check points) and verify those parameters by other means.
- When possible, make use of databases that store the existent car models and the correspondent configurations.
- For enforcement agents with executive powers, online access to vehicle registration database is recommended

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

The evidence constitution should be carried out through the data collected by electronic means and by digital photograph. This is only applicable to the enforcement that is made in toll gates or in multi-lane gantries. When the enforcement is made through mobile enforcement, the immediate stopping of the car and the regularization on the situation is preferable, thus not being necessary to constitute evidence of the violation.

Considering the enforcement made in the toll gates or in multi-lane gantries, the identification of the violator, in case of dealing with a national citizen, will have to be carried out through the research of information concerning the owner of the vehicle in databases of adherents that the CI should create and maintain and in which should be registered information about the vehicle and contacts of the owner. In case of dealing with a non-national citizen, the CI/TSP/EFCO should collect all the information about the violation and send it to the CI with which the violator has the contract established.

If no CI for a certain vehicle (=LPN) can be found, the national and other authorities should be handling identification and charging the user, e.g. according to VERA2.

TECHNOLOGY REQUIREMENTS

Considering what was stated on the paragraph “Means”, the technical requirements to constitute evidence of the violation and identify the violator are only applicable to the enforcement made on the toll gates and multi-lane gantries. In this case, the technology to install should respond to the following needs:

Evidence constitution:

- Image capture equipment (the equipment should be certified in the following capabilities: sensitiveness, accuracy, synchronicity, integrity);
- Systems for automatic license plate recognition;
- Systems for determining vehicle model and configuration (e.g. cameras and optical pattern recognition)
- Database to collect data related to the violation (time and place information, data read from the OBU, license plate number, …).

Identification of violator:

- Database to collect data related to the adherents of the system, including identification and contacts of the owner of

the vehicle (phone number, address, …) and information about the vehicle (for example, license plate number);

- System that searches in this database information about the vehicle and its owner and that correlates this information with the data collected about the violation, producing a violation report to be used as a starting point for the recovery process.

PROCEDURE TO VIOLATION PURSUANCE

The procedure that should be carried through in order to regularize the situation, should be the following, depending on the nationality of the vehicle:

National Vehicles:

- Identification of the violator based on the information read from the OBU and the data registered in the adherents database;
- Notification (via sms, phone call, letter, registered letter, ...) of the violator to inform about the necessity to regularize the situation - this notification can assume different degrees of reliability, as the intended level of insistence (for example, a phone call allows a higher reliability degree than a sms).
- Registry about the violation verified, in order to collect historical data about relapses;
- In case that continued relapse is verified, the owner of the OBU will have to be subject to rescission of the contract, on the basis of its general conditions (for example, after verified x situations of this type);
- In case that the owner of the OBU does not make the necessary efforts to regularize the situation, each country should be free to define what actions should take place.

Non-National Vehicles (inside UE):

- Identification of the origin country of the owner of the OBU through the collection of data registered on the OBU;
- Sending of information (through a private dedicated European network, that should be eNFORCE, defined on the scope of VERA2 report) on the verified situation and respective evidences to the CI with which the contract has been signed so that it can initiate the process of regularization of the situation. This process must follow the guiding lines described above for national vehicles.

RECOMMENDATIONS

- It should be promoted the use of photograph means for constitution of evidence of the violations. In this direction, the legislation in some of the state-members will have to be reviewed so that it could be adapted to this requirement.
- A special sticker (e.g. issued by authorities after a check of registration documents to be glued to windscreen/license plate in such a way that it self-destructs when taken off) or a mandatory non-tolling OBU should be required for vehicles that are not eligible, so that automatic enforcement can rely on this.
- The CI must keep databases to register information concerning the adherent ones that allow their identification in case of verification of irregularities. These databases must regularly be updated and should include information on identification and contacts of the adherent ones.
- It should be defined which entity has the ability to initiate the procedure for the regularization of this kind of situations when the user is a non-national citizen. In this scope, the state members must discuss and define what should be the procedure for the recovery of values in debt by non-national citizens (or the CI with which the contract was

signed pays the value in debt to the TSP/EFCO of the country where the violation took place and then solves internally the issue with their adherent or the TSP/EFCO of the country where the violation took place should have the competence of solving the problem directly with the non-national citizen).

- It should be promoted the use of a private and dedicated network for communication between the different EETS actors. This network must include systems, applications and templates of documents and procedures so that the sharing of information could be effectively done. In this scope, should be used the eNFORCE network, defined in the VERA2 report.
- A regulatory/certification European agency should be set up to address issues related to legal procedures, relationships between EETS actors, etc..
- It should be defined procedures for certification of the equipment used on the determination of the parameters of the vehicle class (like cameras, pressure sensors and others).
- Maintenance of OBU (for users with contract) and LP (for users with no contract) black lists by authorized governmental organizations that participate in the eNFORCE network, for initiation of the violation process.
- Online access of control agents with executive powers at least to their national vehicle registration databases should be established.
- For all vehicles, the legal requirement for the driver to present full vehicle registration documents for inspection should be established in the legal framework of the EU and all other countries joining EETS.

6.3.2.1.12 Emission class is different from the one declared on the OBU or in the booking system

SITUATION	This situation takes place if the emission class declared on the OBU or in the booking system does not meet the one determined by the enforcement system (that could be RSE, mobile enforcement or database retrieval) or if a vehicle that is eligible to toll based on emission class does not pay toll.

IDENTIFICATION OF THE VIOLATION

MEANS

To make it possible to identify a situation of discrepancy between declared and determined emission class, the means to be made available must guarantee the following tasks:

Declared emission class:

- Reading of the emission class declared on the OBU;
- Database retrieval of the receipt stored in the booking system including the declared emission class (in systems that allow booking).

Determined emission class:

- Identification of the model and type of vehicle and look-up of typical emission class for this type;
- Database retrieval of vehicle's emission class
  - From CIs databases
  - From national or other vehicle registration databases – at least for suspect cases and possibly through authorities.
- In case of mobile enforcement: Stopping vehicle and checking registration documents in case of doubt

Verification:

- Comparison of the determined emission class and the one declared by the user.

TECHNOLOGY REQUIREMENTS

Based on the necessities identified in the previous paragraph, the recommended technology requirements must be determined depending on the enforcement point: toll gates and multi-lane gantries or patrol-cars in mobile enforcement and the definition of axle counting an the relevant tolling context.

Toll Gates / Multi-lane Gantries:

In this case, the technology requirements that should be guaranteed are:

- Equipment for identifying vehicle model and configuration (for example, cameras and optical pattern recognition to identify vehicle model and configuration, , …);
- Equipment to communicate to central databases;
- System to compare the information read from the OBU or declared in the booking and the one which is measured by the RSE.

Mobile enforcement:

If we consider the enforcement made by the patrol-cars, the technology requirements are:

- DSRC equipment (DSRC *mobile system*) to read the relevant data stored on the OBU;
- The vehicle model and configuration identification should be done visually by the patrol agents, and, in case of doubt, these agents should be legally competent to stop the car (on the emergency lane or in check points) and verify those parameters by other means.
- When possible, make use of databases that store the existent car models and the correspondent configurations.
- For enforcement agents with executive powers, online access to vehicle registration database is recommended

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

The evidence constitution should be carried out through the data collected by electronic means and by digital photograph. This is only applicable to the enforcement that is made in toll gates or in multi-lane gantries. When the enforcement is made through mobile enforcement, the immediate stopping of the car and the regularization on the situation is preferable, thus not being necessary to constitute evidence of the violation.

Considering the enforcement made in the toll gates or in multi-lane gantries, the identification of the violator, in case of dealing with a national citizen, will have to be carried out through the research of information concerning the owner of the vehicle in databases of adherents that the CI should create and maintain and in which should be registered information about the vehicle and contacts of the owner. In case of dealing with a non-national citizen, the CI/TSP/EFCO should collect all the information about the violation and send it to the CI with which the violator has the contract established.
If no CI for a certain vehicle (=LPN) can be found, the national and other authorities should be handling identification and charging the user, e.g. according to VERA2.

TECHNOLOGY REQUIREMENTS

Considering what was stated on the paragraph “Means”, the technical requirements to constitute evidence of the violation and identify the violator are only applicable to the enforcement made on the toll gates and multi-lane gantries. In this case, the technology to install should respond to the following needs:

Evidence constitution:

- Image capture equipment (the equipment should be certified in the following capabilities: sensitiveness, accuracy, synchronicity, integrity);
- Systems for automatic license plate recognition;
- Systems for determining vehicle model and configuration (e.g. cameras and optical pattern recognition)
- Database to collect data related to the violation (time and place information, data read from the OBU, license plate number, …).

Identification of violator:

- Database to collect data related to the adherents of the system, including identification and contacts of the owner of the vehicle (phone number, address, …) and information about the vehicle (for example, license plate number);
- System that searches in this database information about the vehicle and its owner and that correlates this information with the data collected about the violation, producing a violation report to be used as a starting point for the recovery

process.

PROCEDURE TO VIOLATION PURSUANCE

The procedure that should be carried through in order to regularize the situation, should be the following, depending on the nationality of the vehicle:

National Vehicles:

- Identification of the violator based on the information read from the OBU and the data registered in the adherents database;
- Notification (via sms, phone call, letter, registered letter, ...) of the violator to inform about the necessity to regularize the situation - this notification can assume different degrees of reliability, as the intended level of insistence (for example, a phone call allows a higher reliability degree than a sms).
- Registry about the violation verified, in order to collect historical data about relapses;
- In case that continued relapse is verified, the owner of the OBU will have to be subject to rescission of the contract, on the basis of its general conditions (for example, after verified x situations of this type);
- In case that the owner of the OBU does not make the necessary efforts to regularize the situation, each country should be free to define what actions should take place.

Non-National Vehicles (inside UE):

- Identification of the origin country of the owner of the OBU through the collection of data registered on the OBU;
- Sending of information (through a private dedicated European network, that should be eNFORCE, defined on the scope of VERA2 report) on the verified situation and respective evidences to the CI with which the contract has been signed so that it can initiate the process of regularization of the situation. This process must follow the guiding lines described above for national vehicles.

RECOMMENDATIONS

- It should be promoted the use of photograph means for constitution of evidence of the violations. In this direction, the legislation in some of the state-members will have to be reviewed so that it could be adapted to this requirement.
- A special sticker (e.g. issued by authorities after a check of registration documents to be glued to windscreen/license plate in such a way that it self-destructs when taken off) or a mandatory non-tolling OBU should be required for vehicles that are not eligible, so that automatic enforcement can rely on this.
- The CI must keep databases to register information concerning the adherent ones that allow their identification in case of verification of irregularities. These databases must regularly be updated and should include information on identification and contacts of the adherent ones.
- It should be defined which entity has the ability to initiate the procedure for the regularization of this kind of situations when the user is a non-national citizen. In this scope, the state members must discuss and define what should be the procedure for the recovery of values in debt by non-national citizens (or the CI with which the contract was signed pays the value in debt to the TSP/EFCO of the country where the violation took place and then solves internally the issue with their adherent or the TSP/EFCO of the country where the violation took place should have the competence of solving the problem directly with the non-national citizen).

- It should be promoted the use of a private and dedicated network for communication between the different EETS actors. This network must include systems, applications and templates of documents and procedures so that the sharing of information could be effectively done. In this scope, should be used the eNFORCE network, defined in the VERA2 report.
- A regulatory/certification European agency should be set up to address issues related to legal procedures, relationships between EETS actors, etc..
- It should be defined procedures for certification of the equipment used on the determination of the parameters of the vehicle class (like cameras, pressure sensors and others).
- Maintenance of OBU (for users with contract) and LP (for users with no contract) black lists by authorized governmental organizations that participate in the eNFORCE network, for initiation of the violation process.
- Online access of control agents with executive powers at least to their national vehicle registration databases should be established.
- For all vehicles, the legal requirement for the driver to present full vehicle registration documents for inspection should be established in the legal framework of the EU and all other countries joining EETS.

6.3.2.1.13 Dual-tire vehicle condition is not properly recorded in the OBU

SITUATION	The situation may occur when a dual-tire HGV enters a toll motorway without its OBU dataset being consistent with its wheel configuration and this is detected by classification/enforcement equipment.

IDENTIFICATION OF THE VIOLATION

MEANS

To make it possible to identify a situation of discrepancy between registered and measured dual-tire parameter, the means to be made available must guarantee the following tasks:

Reading of the parameters that identify the dual-tire condition stored on the OBU (this is only applicable to HGV vehicles using Spanish motorways under the definition of the EETS);

Measurement, on the basis of the vehicle analysis, of the real value of this parameter;

Comparison of the measured class and the one obtain from the OBU information.

TECHNOLOGY REQUIREMENTS

Based on the necessities identified in the previous paragraph, the recommended technology requirements must be determined exclusively at: toll gates and multi-lane gantries.

Toll Gates / Multi-lane Gantries:

In this case, the technology requirements that should be guaranteed are:

- DSRC equipment (DSRC *beacon*) / IR equipment to read the relevant parameters stored on the OBU;
- Equipment for measuring the parameters that define the vehicle class (in this case dual-tire detection);
- System to compare the information read from the OBU and that one which is measured by the RSE.

Mobile enforcement:

- DSRC portable equipment (DSRC *mobile system*) to detect/read the OBU (the detection and reading of the license plate will be visually).

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

The evidence constitution should be carried out through the data collected by electronic means and by digital photograph. This is only applicable to the enforcement that is made in toll gates or in multi-lane gantries.

Considering that the enforcement made on toll gates or multi-lane gantries, the identification of the violator, in case of dealing with a national citizen, will have to be carried out through the research of information concerning the owner of the vehicle in databases of adherents that the CI should create and maintain and in which should be registered information about the vehicle and contacts of the owner. In case of dealing with a non-national citizen, the TSP/EFCO should collect all the information about the violation and send it to the CI with which the violator has the contract

established. Then, this entity is responsible for initiate the procedure of recovering the values indebt, like it would do in case of a national citizen.

TECHNOLOGY REQUIREMENTS

Considering what was stated on the paragraph "Means", the technical requirements to constitute evidence of the violation and identify the violator are:

Evidence constitution:

- Vehicle classification system equipped with dual-tire detection capabilities;
- Cameras to take a picture at the moment of the violation (these should be certified in what concerns the timestamp of the violation and non manipulation of data attached to the photograph);
- Systems to automatic license plate recognition;
- Database to collect data related to the violation (time and place information, data read from the OBU, license plate number, …).

Identification of violator:

- Database to collect data related to the adherents of the system, including identification and contacts of the owner of the vehicle (phone number, address, …) and information about the vehicle (for example, license plate number);
- System that searches in this database information about the vehicle and its owner and that correlates this information with the data collected about the violation, producing a violation report to be used as a starting point for the recovery process.

PROCEDURE TO VIOLATION PURSUANCE

The procedure that should be carried through in order to regularize the situation, should be the following, depending on the nationality of the vehicle:

National Vehicles:

- Identification of the violator based on the information read from the OBU and the data registered in the adherents database;
- Notification (via sms, phone call, letter, registered letter, ...) of the violator to inform about the necessity to regularize the situation - this notification can assume different degrees of reliability, as the intended level of insistence (for example, a phone call allows a higher reliability degree than a sms).
- Registry about the violation verified, in order to collect historical data about relapses;
- In case that continued relapse is verified, the owner of the OBU will have to be subject to rescission of the contract, on the basis of its general conditions (for example, after verified x situations of this type);
- In case that the owner of the OBU does not make the necessary efforts to regularize the situation, each country should be free to define what actions should take place.

Non-National Vehicles (inside UE):

- Identification of the origin country of the owner of the OBU through the collection of data registered on the OBU;
- Sending of information (through a private dedicated european network, that should be eNFORCE, defined on the

scope of VERA2 report) on the verified situation and respective evidences to the CI with which the contract has been celebrated so that it can initiate the process to regularize the situation. This process must follow the guiding lines described above for national vehicles.

RECOMMENDATIONS

- Non-Spanish HGV drivers using toll motorways in that country are recommended to request their EFC OBU providers to set the unit parameters in accordance with the EETS rules concerning dual-tire classification.
- It should be promoted the use of photograph means for constitution of evidence of the violations. In this direction, the legislation in some of the state-members will have to be reviewed so that it could be adapted to this requirement.
- The CI must keep databases to register information concerning the adherent ones that allow their identification in case of verification of irregularities. These databases must regularly be updated and should include information on identification and contacts of the adherent ones.
- It should be defined which entity has the ability to initiate the procedure for the regularization of this kind of situations when the user is a non-national citizen. In this scope, the state members must discuss and define what should be the procedure for the recovery of values in debt by non-national citizens (or the CI with which the contract was celebrated pays the value in debt to the TSP/EFCO of the country where the violation took place and then solves internally the issue with their adherent or the TSP/EFCO of the country where the violation took place should have the competence of solving the problem directly with the non-national citizen).
- It should be promoted the use of a private and dedicated network for communication between the different EETS actors. This network must include systems, applications and templates of documents and procedures so that the sharing of information could be effectively done. In this scope, should be used the eNFORCE network, defined in the VERA2 report.
- A regulatory/certification european agency should be set up to address issues related to legal procedures, relationships between EETS actors, etc..
- It should be defined procedures for certification of the equipment used on the determination of the parameters of the vehicle class (like cameras, pressure sensors and others).

6.3.2.1.14 Problems in OBU reading and communication interference between rse and obu

SITUATION

1. **Problems in OBU reading**
   Situation that could occur when a vehicle passes an enforcement point and the RSE could not read the information registered on the OBU.

2. **Communication Interference between the RSE and the OBU**
   This situation can occur when the RSE equipment can not read/write information from/on the OBU because of other equipment interference.

Both situations are treated in one description because they are very similar.

IDENTIFICATION OF THE VIOLATION

MEANS

To identify this situation it is necessary that the RSE (on toll gates/gantries) detects a vehicle passing through and cannot read the information registered on the OBU installed in the vehicle. This can occur due to :

- A malfunction of the RSE;
- A malfunction of the OBU (OBU installed in an inappropriate location, windshield with a layer that make impossible the DSRC communication, OBU battery with no charge);
- Communication interference.

In either of these situations the enforcement procedure shall be initiated.

TECHNOLOGY REQUIREMENTS

The technology that is required to detect the occurrence of this kind of violation is, depending on the type of enforcement considered;

Toll gates / Multi-lane gantries:

- Equipment for automatic vehicle detection (as tri-dimensional scanners, induction loops, pressure detectors, …)
- Road-side DSRC equipment.

Mobile enforcement:

- DSRC portable equipment.

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

The evidence constitution should be performed depending of the means of detecting the violation.

Violation detected by Toll Gates or Multi Lane Gantries:

The data collected by the control station (RSE) e.g.

- basic parameters measured by the laser scanners (see above at section "Technology Requirements") and the classification of the vehicle,
- the DSRC communication parameters if available or the information (with the available communication parameters) that no communication with the OBU could be performed ,
- the digital photographs of the vehicle, which allows the manual classification of the vehicle
- the digital photograph of the license plate of the vehicle
- the time stamp and the location of the event

should be signed by a qualified digital signature and stored in a secure local storage medium and transmitted to the manually enforcement center and again stored in a secure storage medium. This storage medium should be prevented against unauthorized access.

Mobile enforcement:

The data collected by the MEO in the mobile enforcement vehicle e.g.

- The classification of the vehicle manually performed by the MEO
- the digital photographs of the vehicle which allows the subsequent manual classification of the vehicle
- the digital photograph of the license plate of the vehicle
- the DSRC communication parameters if available or the information (with the available communication parameters) that communication with the OBU could not be performed ,
- the name and personal number of the MEO which detected the violation
- the time stamp and the location of the event

should be signed by a qualified digital signature and stored in a secure local storage medium in the mobile enforcement equipment and transmitted to the manually enforcement center and again stored in a secure storage medium. This both storage media should be prevented against unauthorized access.

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TECHNOLOGY REQUIREMENTS

The technical requirements to constitute evidence of the violation and to identify the OBU's owner are only applicable to the enforcement made on check-points or toll gates/gantries. In this case, the technology to install should be the following:

Evidence constitution:

- Image capture equipment (the equipment should be certified in the following capabilities: sensitiveness, accuracy, synchronicity, integrity);
- Systems to automatic license plate recognition;
- Database to collect data related to the violation (time and place information, license plate number, …).

Identification of the OBU owner:

- Database to collect data related to the adherents of the system, including identification and contacts of the owner of

the vehicle (phone number, address, …) and information about the vehicle (for example, license plate number);

- System that searches in this database information about the vehicle and its owner and that correlates this information with the data collected about the violation producing a report that will support the debt recovery process.
- If the violation occurs with frequency for the same OBU owner it should be recorded all the violations and owner's identification in a list ("black-list") that should be available for all EETS actors.

PROCEDURE TO VIOLATION PURSUANCE

In order to regularize the situation the following procedures should be applied, depending on the nationality of the vehicle:

National Vehicles:

- Identification of the violator based on the information read from license plate and the data registered in the adherents database;
- Notification (via sms, phone call, letter, registered letter, ...) of the OBU owner to inform about the necessity to regularize the situation - this notification can assume different degrees of reliability, as the intended level of insistence (for example, a phone call allows a higher reliability degree than a sms).
- Registration of the verified violation, in order to collect historical data about relapses;
- In case that repeated relapse is verified, the owner of the OBU will have to be subject to rescission of the contract, on the basis of its general conditions (for example, after verified x situations of this type);
- In case that the owner of the OBU does not make the necessary efforts to regularize the situation, each country should be free to define what actions should take place.

Non-National Vehicles (inside UE):

- Identification of the origin country of the owner of the OBU or the vehicle by evaluation of the license plate;
- Transmission of data concerning (through a private dedicated european network, that should be eNFORCE, defined on the scope of VERA2 report or a similar network) the evidences of violations to the CI with which the contract has been signed in order he can initiate the process of pursuing the claims of fees and fines. This process must follow the guidelines described above for national vehicles.

RECOMMENDATIONS

- Secure digital photograph should be promoted for constitution of evidence of the violations. The digital photograph should be secured by a qualified digital signature. In this direction, the legislation in some of the state-members will have to be reviewed so that it could be adapted to this requirement.
- The CI must keep databases concerning the adherents in order to identify them in case of verification of irregularities. These databases must be kept actual in real time and should include information on identification and contacts of the adherent ones.
- It should be defined which entity has the ability to initiate the procedure for pursuance of the violations when the user is a non-national citizen. In this scope, the state members must discuss and define what should be the procedure for the recovery of values in debt (toll fee and/or fine due to violation) by non-national citizens e.g.:
    - the CI with which the contract was signed pays the value in debt to the TSP/EFCO of the country where

the violation took place and then solves internally the issue with their adherent
    - or the TSP/EFCO of the country where the violation took place should have the competence of solving the problem directly with the non-national citizen).
- It should be promoted the use of a private or public dedicated network for communication between the different EETS actors. This network must include systems, applications and templates of documents and procedures so that the information could be shared effectively. In this scope the eNFORCE network, defined in the VERA2 report, should be used.
- A regulatory/certification European agency should be set up to address issues related to legal procedures, relationships between EETS actors, etc..
- It should be defined procedures for certification of the equipment used on the determination of the parameters of the vehicle class (like cameras, pressure sensors and others).

6.3.2.1.15 No success on the registry of the entry toll code in the OBU

SITUATION	This situation can take place when a vehicle passes an electronic entry toll gate and the RSE is not able to write information about that toll road entry point on the OBE.

IDENTIFICATION OF THE VIOLATION

MEANS

This type of situations can occur in motorways with closed DSRC toll system installed (see also section 1.2.1.17) and should be treated differently depending on the type of exit lane (electronic or manual):

Entrance and exit in electronic lane:
If the entrance and the exit are made in electronic lanes, this situation can result from problems in writing on the entry toll. This problems are detailed in the table bellow:

Entrance point	Problems in OBU	Battery
	Problems in RSE	Antenna, lane controller, barrier controller
	Inappropriate use of OBU	Wrong location of OBU, OBU not fixed on the windshield
	Fraud	No OBU

System with manual exit lane:
In this system, the situation can occur due to the reasons stated in the table above or due to a vehicle passing in a electronic lane in the motorway entrance and passing an manual lane on the way out.

In both systems (and considering that mobile enforcement will be available) in order to detect the violation, it will be always necessary to have available the entrance information of all vehicles on the road be manually or electronically made available, since it will record information on the entrance toll (date, time and place).

TECHNOLOGY REQUIREMENTS

Based on the exposed in the previous point, the technology requirements will be defined according to the enforcement points considered: exit lanes or mobile enforcement.

Exit lanes:
The verification systems to install in the exit lanes are those used in a normal case. So the technology requirements are:

- DSRC equipment (DSRC *beacon*) to read the relevant data stored on the OBU;
- Automatic verification process of the information related with the entrance (date, time and place) performed by a lane computer.

If no match can be performed by the exit RSE or the lane computer of a manual lane, the violation happened and the enforcement procedure should be initiated.

Mobile enforcement

Considering that a vehicle circulating in a tolled road must have a registry in the OBU about the entrance point, the verification made by the patrol cars must validate if the information registered in the OBU contains the data related with the entrance (date, time, place,…). So, the needed equipment is:

- DSRC equipment (DSRC *mobile system*) to read the relevant data stored on the OBU;
- The patrol agents must have information of all possible entrances and then compare them with the data read from the OBU, in order to make the validation.

MEANS

When enforcement is made in toll gates or in multi-lane gantries, the constitution of evidence will have as basis the information obtained through electronic reading of the OBU and it should be complemented with the entrance toll log and with the photographs of the vehicle captured on the entrance and exit toll. It should also be taken into account the route declared by the driver.

When the enforcement is made through mobile units, it should be promoted the immediate stopping of the car and the regularization on the situation, thus not being necessary to constitute evidence of the violation. In this case it should also be taken into account the declaration of route declared by the driver.

The identification of the violator, in the case of being a national citizen, will have to be made trough a search on the database of all adherents of the EFC system, in which will have to be stored the information related to the vehicle, owner identification and personal contacts.

In case of dealing with a non-national citizen, the TSP/EFCO should collect all the information about the violation and send it to the CI with which the violator has the contract established.

TECHNOLOGY REQUIREMENTS

For the constitution of the evidence, will have to be used, regarding the technical aspects, the following equipments:

- A database to stored information related with all violation made (including date, time, type of violation, data read from the OBU, license plate, among others);
- Equipment to capture images (photos or videos, with or without infrared flash, with or without ALPR system) of the vehicle in the passing points (entrance and exit).

For the identification of the violator, the technical requirements to consider will be:

- Database with information of all adherents of the EFC system (mainly with identification information, personal contacts and with the vehicle's information).
- Global black-lists that should be created by the CI of each country, with information related to the users, based on clear and acceptable rules. These databases should have periodical updates and should be distributed among all TSP/EFCO/CI in the EFC system.
- Make use of privileged communication channels in order to have a high level of information sharing and considering to use the eNFORCE network resulting from the VERA2 project.

PROCEDURE TO VIOLATION PURSUANCE

The procedures to implement with the objective to regularize this situation should be (depending if it is a national or non-national vehicles):

National Vehicles:

- The identification of the OBU's owner made through the searching of information in the database of all adherents of the EFC system;
- Comparison between the OBU involved in the violation under examination and the irregular situations registered in the logs of the possible entrance points for that vehicle. If a positive match is reached and it is verified that the violation should be attributed to the user, charge him the respective fee/toll and a penalty if necessary (depending on national definition in what concerns with this subject).
- Registry about the violation verified, in order to collect historical data about relapses;
- In case that continued relapse is verified, the owner of the OBU will have to be subject to rescission of the contract, on the basis of its general conditions;

Non-National Vehicles (inside U.E.):

- Identification of the OBU owner's country, made through the reading of the information registered in the OBU;
- Contact the CI of the OBU owner's country in order to identify the violator and send (through a private dedicated european network, that should be eNFORCE, defined on the scope of VERA2 report) all information and evidences related to the violation, so the CI could start the regularization process. This process should follow the guiding lines described in the previous points, related to the national vehicles.

RECOMMENDATIONS

- The CI should have legal databases in order to identify the users in case of an irregular situation. These databases should be periodically updated and must include the identification and personal contact of the OBU owner.
- The CI should create and maintain "black-lists" with information about users that consistently commit aggravated fraud (for example, by financial means – non payments, citizen identified in some bank black list, etc.) against the EETS – the rules for the inclusion of these users in the "black-lists" should be discussed and approved by the state-members and, if necessary, some national legislation should be adapted in order to implement the approved solution.
- The CI should create and maintain "grey-lists" with information about users that have propensity to violate – the rules for the inclusion of these users in these lists should also be discussed and approved by the state-members and, if necessary, some national legislation should be adapted in order to implement the approved solution.
- It should be promoted the use of images for the constitution of evidence of the violations. So, maybe it will be necessary to adapt the national legislation of some state-members in order to implement this recommendation. Some aspects to consider are:
  - The possibility to capture of images from the front-side or from the rear-side or from both sides of the vehicle;
  - The possibility to archive all images or only of the irregular / violation situations;
  - The possibility to record and archive panoramic images of vehicles in situation of violation (and not only those which capture only the licence plate);

  - The possibility to record and archive a panoramic image of the passing vehicle with the recognition of the license plate;
  - The certification of the data attached to the photographs;
  - Other situation that might be considered.
- In case of a violation situation with a non-national vehicle, it should be defined whether the process of regularisation should be carried out by the CI with which the contract was signed or, in alternative, if this process should be carried out by the TSP/EFCO of the country in which the violation took place.
- In case of this type of violation take place, the analysis should be made considering the principle of good-faith of the user and accepting his declaration for the route made.
- It should be promoted the use of a private and dedicated network for communication between the different EETS actors. This network must include systems, applications and templates of documents and procedures so that the sharing of information could be effectively done. In this scope, should be used the eNFORCE network, defined in the VERA2 report.
- In closed toll systems, the DSRC beacon should also be installed in the toll lanes with manual ticketing in order to read the OBU installed on vehicles that for mistake or intention use the entrance by manual toll lane and the exit by the electronic toll lane.
- It should be considered a fixed installation of the OBUs to vehicles, in order to avoid some irregular / violation situations.
- Having the license plate of the vehicle stored in the EOBE would facilitate the enforcement process and in thus recommended not only for HGVs but light vehicles as well.
- The reliability of the EETS depends on the fact that all accepted EETS actors comply with a basic set of rules. The acceptance minimum requirements shall be part of a MoU.

6.3.2.1.16 GNSS receiver malfunction

SITUATION	This situation occurs when the GNSS receiver installed on the vehicle is not working properly and, for that reason, the OBU does not identify the use of a toll road. In that case no toll transactions and no payments are processed.

IDENTIFICATION OF THE VIOLATION

MEANS

If a GNSS receiver has a malfunction, the main component of a GNSS-system is not available for identifying the use of a toll road. Even if the OBU works with further sensors, the loss of the GNSS signal will lead to a loss of the operational readiness of the OBU. In these cases no charging will happen.

Normally, the OBU has to identify the malfunction and inform the user about the missing operational readiness of his OBU. Only in case the user ignores the relevant signal this is a violation. Therefore, the enforcement system has to differentiate between:

- System malfunction with no indication. This is, the *malfunction flag* is not activated;
- *Malfunction flag* is activated, but the user does not proceed as expected (then incurring in violation).

In order to identify the violation, the means for vehicle detection, verification and information capturing are needed, with special interest on:

- Information on OBU status at the (virtual) charging point;
- Information on OBU status at the enforcement point;
- Reason for malfunction (e.g. GNSS antenna broken, loose connection), if applicable.

TECHNOLOGY REQUIREMENTS

This type of situation is possible to happen in GNSS-based EFC systems, in which the enforcement is made on toll gantries and/or on check points and through patrol cars. For each one of these enforcement means, the required technology on identifying the situation is:

Toll gantries:

- Equipment for automatic vehicle detection (as tri-dimensional scanners, loops, pressure detectors, …)
- DSRC equipment to read the OBU data, including information of current status and status at time of (virtual) charging point.

Mobile enforcement:

- DSRC portable equipment.

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

Besides the typically used information (like place, date, time, fee/toll, etc.) the data collected in order to constitute evidence on a violation due to a GNSS receiver malfunction must include information on OBU status at the (virtual) charging point, information on OBU status at the enforcement point and, if applicable, the reason that caused the malfunction (e.g. GNSS antenna broken, loose connection).

The identification of the violator, in the case of being a national citizen, will have to be made trough research on the database of all adherents of the EFC system. In case of dealing with a non-national citizen (within UE), the TSP/EFCO should collect all the information about the violation and send it to the CI with which the violator has the contract established so that it can identify the violator.

TECHNOLOGY REQUIREMENTS

In GNSS/CN systems a DSRC link between RSE or mobile equipment is (usually) necessary to get the receipt/ticket of the charging event. Besides the regular enforcement technologies (s. above and other cases) this scenario requires additional data within the communication protocol between RSE/mobile enforcement units and the OBU (OBU status, logfiles etc.).
In case of stationary enforcement points (RSE) this data has to be stored and made readable for analysis within the violation handling procedure in the back office.

In case of mobile enforcement the access to the OBU data is needed. This could be realized by portable DSRC units with special storage possibility for the sanctioning procedures.

PROCEDURE TO VIOLATION PURSUANCE

The procedure for regularization will depend whether the user is responsible for the occurrence of the violation or not.
If the user was informed (through the activation of the *malfunction flag*) that the GNSS receiver had problems and did nothing in order to solve the situation, this must be considered as a violation and he should be demanded to do the payment of the fee/toll value plus a fine.
In cases where the *malfunction flag* was not activated, the user should not pay the fine, although he should be asked to pay the fee/toll.

RECOMMENDATIONS

- The obligations of the user regarding the usage of the OBU should be identified (e.g. use of the OBU only with signal for operational readiness, otherwise use of alternative charging system [booking system in Germany]).
- The user should be informed about these obligations.
- The OBU should include mechanisms to inform the user of OBU malfunctions with loss of operational readiness.
- The enforcement should have the possibility to identify the "responsibility" for not being charged:
  - User -> Violation
  - OBU (= charging system) -> No Violation
- The relevant data about the status of the OBU (time of charging, time of enforcement) has to be stored for

enforcement and sanctioning purposes.

6.3.2.1.17 Passing an exit toll without information about the entrance

SITUATION	Situation that can occur when a vehicle passes an exit toll and the OBU installed has no information on the entrance toll. This situation is only applicable to closed DSRC toll systems.

IDENTIFICATION OF THE VIOLATION

MEANS

This type of situations can occur in motorways with closed DSRC toll system installed and should be treated differently depending on the type of lane (electronic or manual):

Entrance and exit in electronic lane:

If the entrance and the exit are made in electronic lanes, this situation can result from two reasons: problems in writing on the entry toll or problems reading in the exit toll. Each of them are detailed in the table bellow:

Entrance point	Problems in OBU	Battery
	Problems in RSE	Antenna, lane controller, barrier controller
	Inappropriate use of OBU	Wrong location of OBU, OBU not fixed on the windshield
	Fraud	No OBU
Exit point	Problems in OBU	Application layer malfunction
	Problems in RSE	Antenna, lane controller, barrier controller
	Fraud	Data clearing – tampering flag on, dummy OBU

System with manual lane:

In this system, the situation can occur due to the reasons stated in the table above or due to a vehicle passing in a manual lane in the motorway entrance and passing an electronic lane on the way out (unless the entrance toll is also equipped with a DSRC beacon).

In both systems (and considering that mobile enforcement will be available) in order to detect the violation, it will be always necessary to read the information of the OBU, since it will record information on the entrance toll (date, time and place).

TECHNOLOGY REQUIREMENTS

Based on the exposed in the previous point, the technology requirements will be defined according to the enforcement points considered: exit lanes or mobile enforcement.

Exit lanes:

The verification systems to install in the exit lanes are those used in a normal case. So the technology requirements

are:

- DSRC equipment (DSRC *beacon*) to read the relevant data stored on the OBU;
- Automatic verification process of the information related with the entrance (date, time and place) performed by a lane computer.

Mobile enforcement

Considering that a vehicle circulating in a tolled road must have a registry in the OBU about the entrance point, the verification made by the patrol cars must validate if the information registered in the OBU contains the data related with the entrance (date, time, place,…). So, the needed equipment is:

- DSRC equipment (DSRC *mobile system*) to read the relevant data stored on the OBU;
- The patrol agents must have information of all possible entrances and then compare them with the data read from the OBU, in order to make the validation.

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

When enforcement is made in toll gates or in multi-lane gantries, the constitution of evidence will have as basis the information obtained through electronic reading of the OBU and it should be complemented with the entrance toll log and with the photographs of the vehicle captured on the entrance and exit toll. It should also be taken into account the route declared by the driver.

When the enforcement is made through mobile units, it should be promoted the immediate stopping of the car and the regularization on the situation, thus not being necessary to constitute evidence of the violation. In this case it should also be taken into account the declaration of route declared by the driver.

The identification of the violator, in the case of being a national citizen, will have to be made trough a search on the database of all adherents of the EFC system, in which will have to be stored the information related to the vehicle, owner identification and personal contacts.

In case of dealing with a non-national citizen, the TSP/EFCO should collect all the information about the violation and send it to the CI with which the violator has the contract established.

TECHNOLOGY REQUIREMENTS

For the constitution of the evidence, will have to be used, regarding the technical aspects, the following equipments:

- A database to stored information related with all violation made (including date, time, type of violation, data read from the OBU, license plate, among others);
- Equipment to capture images (photos or videos, with or without infrared flash, with or without ALPR system) of the vehicle in the passing points (entrance and exit).

For the identification of the violator, the technical requirements to consider will be:

- Database with information of all adherents of the EFC system (mainly with identification information, personal contacts and with the vehicle's information).

- Global black-lists that should be created by the CI of each country, with information related to the users, based on clear and acceptable rules. These databases should have periodical updates and should be distributed among all TSP/EFCO/CI in the EFC system.
- Make use of privileged communication channels in order to have a high level of information sharing and considering to use the eNFORCE network resulting from the VERA2 project.

PROCEDURE TO VIOLATION PURSUANCE

The procedures to implement with the objective to regularize this situation should be (depending if it is a national or non-national vehicles):

National Vehicles:

- The identification of the OBU's owner made through the searching of information in the database of all adherents of the EFC system;
- Comparison between the OBU involved in the violation under examination and the irregular situations registered in the logs of the possible entrance points for that vehicle. If a positive match is reached and it is verified that the violation should be attributed to the user, charge him the respective fee/toll and a penalty if necessary (depending on national definition in what concerns with this subject).
- Registry about the violation verified, in order to collect historical data about relapses;
- In case that continued relapse is verified, the owner of the OBU will have to be subject to rescission of the contract, on the basis of its general conditions;

Non-National Vehicles (inside U.E.):

- Identification of the OBU owner's country, made through the reading of the information registered in the OBU;
- Contact the CI of the OBU owner's country in order to identify the violator and send (through a private dedicated european network, that should be eNFORCE, defined on the scope of VERA2 report) all information and evidences related to the violation, so the CI could start the regularization process. This process should follow the guiding lines described in the previous points, related to the national vehicles.

RECOMMENDATIONS

- The CI should have legal databases in order to identify the users in case of an irregular situation. These databases should be periodically updated and must include the identification and personal contact of the OBU owner.
- The CI should create and maintain "black-lists" with information about users that consistently commit aggravated fraud (for example, by financial means – non payments, citizen identified in some bank black list, etc.) against the EETS – the rules for the inclusion of these users in the "black-lists" should be discussed and approved by the state-members and, if necessary, some national legislation should be adapted in order to implement the approved solution.
- The CI should create and maintain "grey-lists" with information about users that have propensity to violate – the rules for the inclusion of these users in these lists should also be discussed and approved by the state-members and, if necessary, some national legislation should be adapted in order to implement the approved solution.
- It should be promoted the use of images for the constitution of evidence of the violations. So, maybe it will be

necessary to adapt the national legislation of some state-members in order to implement this recommendation. Some aspects to consider are:

  - The possibility to capture of images from the front-side or from the rear-side or from both sides of the vehicle;
  - The possibility to archive all images or only of the irregular / violation situations;
  - The possibility to record and archive panoramic images of vehicles in situation of violation (and not only those which capture only the licence plate);
  - The possibility to record and archive a panoramic image of the passing vehicle with the recognition of the license plate;
  - The certification of the data attached to the photographs;
  - Other situation that might be considered.

- In case of a violation situation with a non-national vehicle, it should be defined whether the process of regularisation should be carried out by the CI with which the contract was signed or, in alternative, if this process should be carried out by the TSP/EFCO of the country in which the violation took place.
- In case of this type of violation take place, the analysis should be made considering the principle of good-faith of the user and accepting his declaration for the route made.
- It should be promoted the use of a private and dedicated network for communication between the different EETS actors. This network must include systems, applications and templates of documents and procedures so that the sharing of information could be effectively done. In this scope, should be used the eNFORCE network, defined in the VERA2 report.
- In closed toll systems, the DSRC beacon should also be installed in the toll lanes with manual ticketing in order to read the OBU installed on vehicles that for mistake or intention use the entrance by manual toll lane and the exit by the electronic toll lane.
- It should be considered a fixed installation of the OBUs to vehicles, in order to avoid some irregular / violation situations.
- Having the license plate of the vehicle stored in the EOBE would facilitate the enforcement process and in thus recommended not only for HGVs but light vehicles as well.
- The reliability of the EETS depends on the fact that all accepted EETS actors comply with a basic set of rules. The acceptance minimum requirements shall be part of a MoU.

6.3.2.1.18 Inconsistent time/ and place sequences

SITUATION	This situation takes place if observations of the vehicle based on LPN at various times/locations by the enforcement system (that could be RSE, mobile enforcement or database retrieval) are not physically or logically possible or conclusive. This could e.g. be an entry to the road system without an exit, an exit without entry, or observations that imply impossible/improbable speeds, …

IDENTIFICATION OF THE VIOLATION

MEANS

To make it possible to identify such situations, a logical check on observations of the same LPN at various times an places is used based on rules:

Observations via OBU:

- Analysis of traveling data generated by means of OBU
- Cross analysis with data from enforcement system (automated or mobile)
- Cross analysis with data from booking system (where applicable)

Data from Booking Sytem (where applicable):

- Analysis of booking data for consistency
- Cross analysis with data from enforcement system (automated or mobile)
- Cross analysis with data from OBUs

Observations via Enforcement System:

- Analysis of traveling data generated by enforcement system (automated or mobile)
- Cross analysis with data by means of OBU
- Cross analysis with data from booking system (where applicable)

TECHNOLOGY REQUIREMENTS

Based on the necessities identified in the previous paragraph, rule-based analysis of all data for consistency with physics and logics is implemented on the back-end systems

- Rule-based analysis engine for selected or all vehicle data
- Data Base for data to be included in analysis
- Equipment for manual checks at back end to verify rule based automatic analysis and to document final findings
- Possibility to Grey-Listing and/or setting of “viedeo flag” of vehicle to put it under close surveiliance;

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

The evidence constitution should be carried out based the data collected by electronic means and by digital photograph with certified equipment as well as by manual observations by mobile enforcement agents entered into the system. Then automated analysis to filter suspects for final manual analysis needs to be done leading to a well documented

evidence record, why a situation is impossible.

Considering the enforcement made in the toll gates or in multi-lane gantries, the identification of the violator, in case of dealing with a national citizen, will have to be carried out through the research of information concerning the owner of the vehicle in databases of adherents that the CI should create and maintain and in which should be registered information about the vehicle and contacts of the owner. In case of dealing with a non-national citizen, the CI/TSP/EFCO should collect all the information about the violation and send it to the CI with which the violator has the contract established.
If no CI for a certain vehicle (=LPN) can be found, the national and other authorities should be handling identification and charging the user, e.g. according to VERA2.

TECHNOLOGY REQUIREMENTS

Considering what was stated on the paragraph "Means", the technical requirements to constitute evidence of the violation and identify the violator are only applicable to the enforcement made on the toll gates and multi-lane gantries. In this case, the technology to install should respond to the following needs:

Evidence constitution:

- Image capture equipment (the equipment should be certified in the following capabilities: sensitiveness, accuracy, synchronicity, integrity);
- Systems for automatic license plate recognition;
- Systems for automated rule based data analysis and subsequent manual analysis of suspects, providing an eveidence rcord.
- Database to collect data related to the violation (time and place information, data read from the OBU, license plate number, …).

Identification of violator:

- Database to collect data related to the adherents of the system, including identification and contacts of the owner of the vehicle (phone number, address, …) and information about the vehicle (for example, license plate number);
- System that searches in this database information about the vehicle and its owner and that correlates this information with the data collected about the violation, producing a violation report to be used as a starting point for the recovery process.

PROCEDURE TO VIOLATION PURSUANCE

The procedure that should be carried through in order to regularize the situation, should be the following, depending on the nationality of the vehicle:

National Vehicles:

- Identification of the violator based on the information read from the OBU and the data registered in the adherents database;
- Notification (via sms, phone call, letter, registered letter, ...) of the violator to inform about the necessity to regularize the situation - this notification can assume different degrees of reliability, as the intended level of insistence (for

example, a phone call allows a higher reliability degree than a sms).

- Registry about the violation verified, in order to collect historical data about relapses;
- In case that continued relapse is verified, the owner of the OBU will have to be subject to rescission of the contract, on the basis of its general conditions (for example, after verified x situations of this type);
- In case that the owner of the OBU does not make the necessary efforts to regularize the situation, each country should be free to define what actions should take place.

Non-National Vehicles (inside UE):

- Identification of the origin country of the owner of the OBU through the collection of data registered on the OBU;
- Sending of information (through a private dedicated European network, that should be eNFORCE, defined on the scope of VERA2 report) on the verified situation and respective evidences to the CI with which the contract has been signed so that it can initiate the process of regularization of the situation. This process must follow the guiding lines described above for national vehicles.

RECOMMENDATIONS

- It should be promoted the use of photograph means for constitution of evidence of the violations. In this direction, the legislation in some of the state-members will have to be reviewed so that it could be adapted to this requirement.
- The CI must keep databases to register information concerning the adherent ones that allow their identification in case of verification of irregularities. These databases must regularly be updated and should include information on identification and contacts of the adherent ones.
- It should be defined which entity has the ability to initiate the procedure for the regularization of this kind of situations when the user is a non-national citizen. In this scope, the state members must discuss and define what should be the procedure for the recovery of values in debt by non-national citizens (or the CI with which the contract was signed pays the value in debt to the TSP/EFCO of the country where the violation took place and then solves internally the issue with their adherent or the TSP/EFCO of the country where the violation took place should have the competence of solving the problem directly with the non-national citizen).
- It should be promoted the use of a private and dedicated network for communication between the different EETS actors. This network must include systems, applications and templates of documents and procedures so that the sharing of information could be effectively done. In this scope, should be used the eNFORCE network, defined in the VERA2 report.
- A regulatory/certification European agency should be set up to address issues related to legal procedures, relationships between EETS actors, etc..
- It should be defined procedures for certification of the equipment used on the determination of the parameters of the vehicle class (like cameras, pressure sensors and others).
- Maintenance of OBU (for users with contract) and LP (for users with no contract) black lists by authorized governmental organizations that participate in the eNFORCE network, for initiation of the violation process.
- Online access of control agents with executive powers at least to their national vehicle registration databases should be established.
- For all vehicles, the legal requirement for the driver to present full vehicle registration documents for inspection should be established in the legal framework of the EU and all other countries joining EETS

6.3.2.1.19 Vehicle registered in the booking system but whose payment is insufficient

SITUATION	This situation is possible to take place in systems that include booking scheme and it is verified when a vehicle is found in circulating in a motorway or passes an enforcement point outside the scope of the pre-registry previously made.

IDENTIFICATION OF THE VIOLATION

MEANS

The type violation is detected in a DSRC-system (microwave or IR) when the RSE gets the data of the OBU during the initialization procedure. The VST (Vehicle Service Table) sent by the OBU contains in the octet strings # 19 and 20 the contract type which specifies the payment mode. The procedure after the initialization of the communication link reads the relevant data in the OBU. If the pre-payment mode is selected by the owner of vehicle at the initialization of the OBU then an amount for payment specified by the contract provider is loaded into the purse of the OBU associated with the contract. This value of currency in the purse is reduced by each crossing a toll gate by the specific amount of currency associated to the classification of the vehicle and this toll gateway. If the balance in the purse after deduction of the specific amount gets negative or the value in the purse is already negative the OBU signals this event to the RSU and alerts the driver, that the deduction of the toll value could not be performed due to too small currency amount in the purse. The EFC-process in the EN/ISO 14906 standard is already defined in such a way, that the driver is already alerted by the application process of the EFC-system when the remaining value in the purse falls short to a threshold level (defined by the contract provider). The driver is therefore already informed that he should reload the pre-payment purse before he crosses the next toll gate.

TECHNOLOGY REQUIREMENTS

Based on these necessities the recommended technology must be determined depending on the enforcement point: toll gates and multi-lane gantries or Mobile Enforcement Officers (MEO):

Toll Gates / Multi-lane Gantries:

In this case, the technology requirements that should be guaranteed are:

- DSRC equipment (DSRC microwave or IR beacon, RSE) to read the relevant parameters stored in the OBU;
- System inside the RSE which evaluates the corresponding toll amount according to the classification of the vehicle (read out from OBU) and the toll gate and transmits this amount to the OBU for recording and further processing inside the OBU.
- Software process inside the OBU, which deducts the associated toll amount according to the classification of the vehicle and the toll gate from the pre-payment purse and checks the remaining amount in the purse against a predefined threshold value (defined by the contract provider) and/or against zero or smaller.
- System inside the OBU which alerts the driver of the vehicle, when the deduction of the toll amount transmitted by the RSE from the available amount in the purse results in a negative value and therefore the payment process could not be completed successfully.
- If the result of this payment process could not be completed due to not sufficient amount of currency in the purse the enforcement procedure should be initiated.

- If the remaining amount in the purse falls short to a defined threshold value the driver must be alerted that he should reload the purse before crossing the next toll gate.

Mobile enforcement:

If enforcement made by the Mobile Enforcement Officers (MEO) based on obeying free flowing traffic is applied, the technology requirements are:

- DSRC equipment (DSRC *microwave or IR-system*) to communicate with the OBU;
- Classification of the vehicle (e.g. truck with/without trailers) visually by the MEO, and comparison of the class stored and read in OBU with the visual classification of the vehicle.
- If classification is equal or higher check the type of contract (pre-payment or post-payment).
- If pre-payment, check the last n-pre-paid transactions stored in the OBU against the correct values for the corresponding toll gates and the classification of the vehicle.
- If one of the stored transactions in the OBU is smaller than the correct value, it should be alerted to the MEO.
- He should then take one or more digital pictures (in order to manually classify the vehicle) including the license plate for perpetuation of evidence.
- The MEO should be legally legitimated to stop the car (on the emergency lane or in check points) and initiate the enforcement procedure.

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

The evidence constitution should be performed depending of the means of detecting the violation.

Violation detected by Toll Gates or Multi Lane Gantries:

The data collected by the control station (RSE) e.g.

- the data read out of the OBU (VST, license plate number, declared classification, type of contract, contract provider, currency, corresponding toll amount, available amount in pre-payment purse, flag that the driver is alerted about the falling short to the threshold amount in the purse etc),
- the time stamp and the location of the event

should be signed by a qualified digital signature and stored in a secure local storage medium and transmitted to the manually enforcement center and again stored there in a secure storage medium. This storage medium should be prevented against unauthorized access.

Mobile enforcement:

The data collected by the MEO in the mobile enforcement vehicle e.g.

- The classification of the vehicle manually performed by the MEO
- the digital photographs of the vehicle which allows the subsequent manual classification of the vehicle

- the digital photograph of the license plate of the vehicle
- the data read out of the OBU (VST, license plate number, declared classification, type of contract, contract provider, currency, corresponding toll amount, available amount in pre-payment purse, flag that the driver is alerted about the falling short to the threshold amount in the purse etc),
- the name and personal number of the MEO which detected the violation
- the time stamp and the location of the event

should be signed by a qualified digital signature and stored in a secure local storage medium in the mobile enforcement equipment and transmitted to the manually enforcement center and again stored there in a secure storage medium.

This both storage media should be prevented against unauthorized access.

TECHNOLOGY REQUIREMENTS

PROCEDURE TO VIOLATION PURSUANCE

The procedure that should be carried through in order to remedy the situation, should be the following, depending on the nationality of the vehicle:

National Vehicles:

- Identification of the violator based on the information read from the OBU and the data registered in the adherents database;
- Notification (via sms, phone call, letter, registered letter, ...) of the violator to inform about the necessity to remedy the violation - this notification can assume different degrees of reliability, as the intended level of insistence (for example, a phone call allows a higher reliability degree than a sms).
- Registry about the violation verified, in order to collect historical data about relapses;
- In case that continued relapse is verified, the owner of the OBU will have to be subject to rescission of the contract, on the basis of its general conditions (for example, after verified x situations of this type);
- In case that the owner of the OBU does not make the necessary efforts to remedy the situation, each country should be free to define what actions should take place.

Non-National Vehicles (inside UE):

- Identification of the origin country of the owner of the OBU through the collection of data registered on the OBU;
- Sending of information (through a private dedicated european network, that should be eNFORCE, defined on the scope of VERA2 report) on the verified situation and respective evidences to the CI of the contract provider so that it can initiate the process of remedy of the situation. This process must follow the guiding lines described above for national vehicles.

RECOMMENDATIONS

- Secure digital photograph should be promoted for constitution of evidence of the violations. The digital photograph should be secured by a qualified digital signature. In this direction, the legislation in some of the state-members will have to be reviewed so that it could be adapted to this requirement.
- The CI must keep databases concerning the adherents in order to identify them in case of verification of irregularities. These databases must be kept actual in real time and should include information on identification and contacts of the adherent ones.
- It should be defined which entity has the ability to initiate the procedure for pursuance of the violations when the user is a non-national citizen. In this scope, the state members must discuss and define what should be the procedure for the recovery of values in debt (toll fee and/or fine due to violation) by non-national citizens e.g.:
    - the CI with which the contract was signed pays the value in debt to the TSP/EFCO of the country where the violation took place and then solves internally the issue with their adherents
    - or the TSP/EFCO of the country where the violation took place should have the competence of solving the problem directly with the non-national citizen).
- It should be promoted the use of a private or public dedicated network for communication between the different EETS actors. This network must include systems, applications and templates of documents and procedures so that the information could be shared effectively. In this scope the eNFORCE network, defined in the VERA2 report, should be used.
- A regulatory/certification European agency should be set up to address issues related to legal procedures, relationships between EETS actors, etc..
- It should be defined procedures for certification of the equipment used on the determination of the parameters of the vehicle class (like cameras, pressure sensors and others).

The described violation contains some legal uncertainties in so far as the alerting of the driver, when the pre-payment purse falls short to the specified threshold amount should be acknowledged by the driver (e.g. by pressing a button on the OBU or other means) in order to proof that he took care of the alert. This seems necessary as the sound alert by the OBU as it is applied for the time being is in most implementations a short buzz tone and could be missed by the driver of the vehicle in some critical traffic situations which takes his full attention. This missing of the alert due to distraction of the attention could be objected against his responsibility. The acknowledgment of the alert should be integrated in the OBU and the system independently of the toll system used (GNSS/GPRS, DSRC or others).

6.3.2.1.20 Vehicle registered in the booking system but whose route is different from the one declared

SITUATION	This situation is possible in systems that allow pre-booking, where the actual route is different (and more expensive) than the registered one.

IDENTIFICATION OF THE VIOLATION

MEANS

In booking systems the user usually has to declare the complete route which he wants to use (at least in the Germany case). In case of mistakes of the user or fraud a wrong route was chosen in the booking system.

TECHNOLOGY REQUIREMENTS

At the enforcement point the receipt representing the booked route and the declared fee relevant parameters must be available. Depending on the type of enforcement different technologies must be used.

Regular enforcement technologies for vehicle detection, determination of fee relevant data, verification, evidence capturing etc (s. Functional model) are needed, with special interest on receiving the receipt out of a central database.

Toll gates / Multi-lane gantries:

The technology required for the identification of this violation is:

- Equipment for automatic vehicle detection (as tri-dimensional scanners, loops, pressure detectors, …)
- Equipment for image capture and a license plate recognition system
- Online interface to central databases

Mobile enforcement:

The technology that mobile enforcement team has to have to identify this violation is:

- Online interface to central databases

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

In order to constitute evidence of the violation, it should be taken a picture at the moment of the violation (with certified metadata, such as, license plate recognition outcome, location and date of the occurrence) and it should be stored the license plate number recognized by the LPR system installed.

When the vehicle is national, the identification of the vehicle's owner must be made by searching the EFC system adherents' database. When the vehicle is a non-national one, the data collected on the violation should be sent to the CI identified holding a contract for this vehicle so that it can initiate the value recovery process.

If no CI for the vehicle in question can be identified based on the LPN, national and other authorities assistance is required to identify and charge the user.

When the enforcement is made through patrol units, it should be promoted the immediate stopping of the vehicle in the nearest possible site (rest park, gas station, …), the vehicle's driver/owner should be identified at that moment and the situation should be clarified.

TECHNOLOGY REQUIREMENTS

The technology requirements for the evidence constitution of this situation and for the identification of the OBU's owner are:

- Image capture equipment (this should be certified in what concerns the timestamp and non manipulation of data attached to the photograph);
- Automatic license plate recognition system;
- Database to record the information related with this situation (location and date/time where the vehicle was detected);
- Mobile equipment to check valid bookings in database for agents.

Identification of violator :

- Database with information of all adherents of the EFC system, including identification, contacts (phone number, address, …) and vehicle's characteristics (such as license plate number);
- System that searches in this database information about LPN's owner and produces a report to be used in future analyses in case of frequents relapses;
- Privileged communication channels in order to have a high level of information sharing among all EETS actors (considering to use the eNFORCE network resulting from the VERA2 project or a dedicated network of all EETS CIs and Road/Toll Operators) to identify registered / contracted users based on LPN;
- Every passing of a vehicle with a correct, valid booking detected by RSE should lead to "punching the ticket" as used, so that after the validity period of a booking fraudulent claims for return of payment can be detected. In case of a mistake (e.g. typo when booking), the ticket will not be marked as used after end of the validity period, but the passage of the vehicle with the real LPN will have been identified as possible violation by LPR. It is thus possible to check for this using e.g. fuzzy search. In case of fraud, e.g. by using the same ticket for two closely matching LPNs, the double usage can be identified and enforcement action taken.

PROCEDURE TO VIOLATION PURSUANCE

The procedure that should be carried through in order to regularize the situation, depends on the nationality of the LPN's owner:

National License Plate Number (LPN):

- After the identification of the LPN's owner, he should be contacted (by phone call, letter, ...) in order to clarify the situation and then adopt the correct procedure to regularize it (update the information in the database, use the OBU just in the vehicle with the same license plate number, …)
- In case of the OBU's owner does not make the necessary efforts to regularize the situation, each CI should be free to define what actions should take place (evaluate the possibility of rescind the contract), as well as each TSP/EFCO should be free to interdict the OBU's owner of using the service.
- Create a database to record this type of situations in order to use it in future analyses in case of frequent relapses.
- In case of continued relapse is verified, the owner of the OBU could be subject to a contract rescission, based in the

general conditions of the EFC contract (it should be establish between all ETTS actors the inclusion of this clause in the EFC contracts).

Non-National LPN owner (inside EU):

- Identification of the origin country and the CI of the LPN's owner through the collection of data registered on the RSE by LPR;
- Send the information of the verified situation and respective evidences to the CI of the LPN's owner, through a private dedicated european network, that should be eNFORCE network, defined on the scope of VERA2 report, so that it can initiate the process of notification of the LPN's owner to regularize the situation. This process must follow the guiding lines described above for national vehicles.
- If no CI can be identified, the case should be handed over to authorities and be treated in accord with VERA2 via eNFORCE.

In the both cases, the situation should be registered in a database and distributed among all EETS actors, in order to collect historical information for future analyses of relapses.

RECOMMENDATIONS

- The CI must keep databases to register information concerning the adherents of the EFC system, which allow their identification in case of violations. These databases must regularly be updated and should include information on identification incldugin LPN and contacts of the adherents.
- The CI should create and maintain "grey-lists" with information about users that have propensity to violate – the rules for the inclusion of these users in these lists should also be discussed and approved by the state-members and, if necessary, some EU and national legislation should be adapted in order to implement the approved solution.
- The TSP/EFCO/CI should create and maintain "black-lists" with information about users that consistently commit violations or aggravated fraud against the EETS – the rules for the inclusion of these users in the "black-lists" should be discussed and approved by the state-members and, if necessary, some national legislation should be adapted in order to implement the approved solution.
- It should be promoted the use of images for the constitution of evidence of the violations. So, maybe it will be necessary to adapt the national legislation of some state-members in order to implement this recommendation. Some aspects to consider are:
    - The possibility to capture of images from the front-side or from the rear-side or from both sides of the vehicle;
    - The possibility to archive at least of the irregular / violation situations;
    - The possibility to record and archive panoramic images of vehicles in situation of violation (and not only those which capture only the licence plate), especially to allow identification of drivers;
    - The possibility to record and archive a panoramic image of the passing vehicle with the recognition of the license plate;
    - The certification of the data attached to the photographs (for example, time and place information);
    - Other situation that might be considered.
- It should be promoted the use of a private and dedicated network for communication between the different EETS actors. This network must include systems, applications and templates of documents and procedures so that the sharing of information could be effectively done. In this scope, should be used the eNFORCE network, defined in the VERA2 report.
- A regulatory/certification european agency should be set up to address issues related to legal procedures,

relationships between EETS actors, etc..

- In this scope, also clear roles of national authorities and procedures for their cooperation in dealing with toll fraud should be established (legal framework, communications & networks, operating procedures & rules) .
- The reliability of the EETS is dependent of the fact that all accepted EETS actors comply with a basic set of rules. The acceptance minimum requirements shall be part of a MoU.

6.3.2.1.21 License plate hidden / illegible (attempt to inhibit the payment or enforcement)

SITUATION	This situation occurs when the vehicle does not have a license plate or it is covered or it is deteriorated, by usage or by deliberate intention.

IDENTIFICATION OF THE VIOLATION

MEANS

This situation is identified when, at a toll gate or multi-lane gantry, the RSE detects a vehicle passing through in an anomalous situation and, when it triggers the image capture equipment and de LPR, it is not possible to recognize and/or to read the license plate number because it is hidden, illegible or not present (this situation excludes equipment malfunction).

This situation can also occur during a mobile enforcement operation, when the patrol unit detects a vehicle with the license plate in those conditions.

TECHNOLOGY REQUIREMENTS

The technology requirements on toll gates/gantries and on patrol units are.

Toll Gates / Multi-lane Gantries:

- Equipment for automatic vehicle detection (as tri-dimensional scanners, loops, pressure detectors,…);
- DSRC equipment (DSRC *beacon*) to detect the presence OBU;
- Equipment for image capture (from the front-end and rear-end);
- License plate recognition system.

Mobile enforcement:

- DSRC portable equipment (DSRC *mobile system*) to read the OBU (the detection and reading of the license plate, if possible, will be visually).

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

This is a particular situation of violation, in which it is too difficult to identify the violator, because there is no OBU inside the vehicle (so, there is no way to identify if he is an adherent) and the licence plate is not readable (so, there is no means to identify the owner of the vehicle). But although this fact, there is still the need of constitute evidence of the violation, so that it will be possible to recover the values indebt in case of a future identification. The means to do this should be those identified in the past situations.

TECHNOLOGY REQUIREMENTS

The technology requirements for the evidence of the violation and for the identification of the vehicle's owner are:

Evidence constitution:

- Image capture equipment (this should be certified in what concerns the timestamp of the violation and non manipulation of data attached to the photograph);
- Database to collect data related to the violation (time and place information, …).

Identification of violator:

- The identification of the vehicle's driver/owner will be possible only if a mobile patrol unit promote the stop of the vehicle. Then, it is necessary to ask for the identification documents of the vehicle's driver/owner (it is also possible to investigate if the vehicle's driver/owner has a valid EFC contract, searching in the database of adherents).

PROCEDURE TO VIOLATION PURSUANCE

The procedure that should be carried through in order to regularize the situation, is the following:

- After the vehicle in violation was stopped by the mobile patrol unit and the driver/owner be identified, he should be informed of the obligation of having the license plate installed on the correct place and in perfect conditions for visual/digital reading. Not having an OBU, the procedure to follow will most probably depend on the policy of each TSP/Issuer. It may decide if configures a normal violation, it may decide to apply the normal tariff or it may even apply the normal tariff with a specific penalty to cover the extra work. The TSP/Issuer must also decide if the vehicle should be escorted to the nearest exit since it can not circulate in violation.
- If the vehicle's driver/owner has a valid EFC contract he should be subject to a contract rescission based in the general conditions of the EFC contract (each CI should be free to define what actions should take place).
- The violation should be registered in a database (or "grey-list") in order to collect historical information for future analyses of relapses. The TSP/EFCO should be free to interdict the vehicle's driver/owner of using the service.

RECOMMENDATIONS

- All EFC contracts should have a clause related with the obligation of the vehicle be obligated to circulate with a license plate installed on the correct position, in perfect condition for visual/digital reading and also with an OBU installed inside the vehicle.
- It should be promoted the use of images for the constitution of evidence of the violations. So, maybe it will be necessary to adapt the national legislation of some state-members in order to implement this recommendation. Some aspects to consider are:
    - The possibility to capture of images from the front-end or from the rear-end or from both ends of the vehicle;
    - The possibility to archive all images or only of the irregular / violation situations;
    - The possibility to record and archive panoramic images of vehicles in situation of violation (and not only those which capture only the licence plate);
    - The possibility to record and archive a panoramic image of the passing vehicle;
    - The certification of the data attached to the photographs (for example, time &place information);
    - Other situation that might be considered.
- The CI must keep databases to register information concerning the adherents of the EFC system, which allow their identification in case of violations. These databases must regularly be updated and should include information on

identification and contacts of the adherents.

- The state members must discuss and define what should be the procedure for the recovery of values in debt by non-national citizens (the procedures for the TSP/EFCO of the country where the violation took place regularize the debt of the non-national vehicle's owner).
- It should be promoted the use of a private and dedicated network for communication between the different EETS actors. This network must include systems, applications and templates of documents and procedures so that the sharing of information could be effectively done. For this purpose, the use of the eNFORCE network cold be proposed.
- A regulatory/certification european agency should be set up to address issues related to legal procedures, relationships between EETS actors, etc..
- The TSP/EFCO/CI should create and maintain "black-lists" with information about users that consistently commit violations or aggravated fraud against the EETS – the rules for the inclusion of these users in the "black-lists" should be discussed and approved by the state-members and, if necessary, some national legislation should be adapted in order to implement the approved solution.
- The CI should create and maintain "grey-lists" with information about users that have propensity to violate – the rules for the inclusion of these users in these lists should also be discussed and approved by the state-members and, if necessary, some national legislation should be adapted in order to implement the approved solution.
- It should be considered a fixed and non-removable installation of the OBUs to vehicles, in order to avoid some irregular / violation situations.
- The reliability of the EETS is dependent of the fact that all accepted EETS actors comply with a basic set of rules. The acceptance minimum requirements shall be part of a MoU.
- One of the principles that should be considered within the creation and usage of databases with information about the adherents and vehicles' owners and within the exchange of personal data should be the confidentiality of that information. For this purpose, it should be defined the set of rules that should be respected in order to guarantee the protection of that data.

6.3.2.1.22 "Little train" / "Piggybacking" / "Tailgating" (attempt of inhibition of payment)

SITUATION	Situation that occurs when a vehicle (with or without OBU) passes in a toll gate or a multi-lane gantry very close to the vehicle that follows to its front, with the objective to hinder that the system recognizes the two vehicles, reading and registering information only in the OBU of the vehicle in front.
IDENTIFICATION OF THE VIOLATION	
MEANS	

This situation can only happen in free flow or multi-lane DSRC(microwave)-systems, when both vehicles are trucks and the second vehicle is without a nozzle and so close to the vehicle in front that the distance between the back front of the front vehicle and the front of the second vehicle is below 70cm. For this case the first truck shadows the communication zone and the time interval for communication gets to short (<26ms) to initialize the communication link between the RSE and the OBU (5 ms for wake up the OBU according to EN 12253 parameter D10a, 5ms between transmission of the BST, where the first BST wakes up the OBU and the second BST (5ms later) starts the initialization of the communication link, which itself lasts for 4ms. The completion of the EFC-transaction takes additionally about 10-12ms. The total transaction is therefore in the range of 26ms. During this time interval of 26ms the truck moves 72 cm at a speed of 100km/h. The completion of a EFC-transaction requires therefore at least a communication length of 72 cm. But this short distance creates a very dangerous situation at high speed especially for the second vehicle and therefore it is very rare. It can be assumed that such situations require close cooperation of the drivers of the trucks.

Under these assumption that the drivers take this risk and reduce the security distance below 70cm for the length of the communication zone (about 8m) at high speed (about 100km/h) the following procedure can partly reveal this situation and give a chance for prosecution:

Normal DSRC toll gate:

According to the conditions above described the RSE performs the EFC-transaction with the first truck (truck 1) and after this the start of the communication link with the second truck (truck 2) takes place but does not complete. The time interval from the completion of the transaction with truck 1 to the start of communication with truck2 is at the speed of 100km/h in the range of 360ms (truck 1 length 10m) to 900ms for a truck 1 with trailer (total length 25m). The VST (Vehicle Service Table) of the truck 2 could be received in the available time interval of 14ms and contains in the octet strings # 42 – 47 some information which could be used for evaluation for this situation. The octet string 42 starts the OBU Configuration.

		Octet#	Attribute/Field	Bits in
octet	**Description**			
42	OBU Configuration SEQUENCE {			
	OPTION indicator	1		OBU Status present
	Equipment class INTEGER (0.. 32767)	000 0000		Example 3_{10}
43		0000 0011		
44	ManufacturerId INTEGER (0..65535)	0000 0000		Manufacturer Identifier. See EN ISO 14816 Register Example 2_{10}

45		0000 0010	
46	OBU Status INTEGER (0..65535)	0000 0011	Example 768_{10}
47		0000 0000	

At the octet string 46 starts the transaction counter of the EFC. It is incremented by 1 for each successful transaction. With this transaction counter the abuse or violation of the above described situation can be controlled, as it is not incremented in this situation. The OBU Configuration of such uncompleted communication links of several sequencing toll gates (beacons) which contains the same OBU configuration data, especially with the same ManufacturerID and the same OBU Status points to this violation.

Stationary Enforcement Gate (DSRC):

At stationary Enforcement sites the described situations can be detected more easily because the laser scanners detects this situations of very close driving trucks as the second truck is not interpreted as a trailer, while the trucks are not connected by a trailer coupling. As the following truck 2 is to short behind the truck 1 no digital picture can be made, but too to the assumed cooperation of the drivers the digital pictures taken at the enforcement gate should not be deleted if the first truck does not violate the toll conditions but a to close truck is detected by the laser scanner. This situation can be manually evaluated and the enforcement procedure initiated.

The described situation can only happen at microwave DSRC-systems. GNSS/GPRS systems are not sensitive to such situations. Infrared-DSRC-systems are only sensitive to such situations when the speed of the communication link is below 2Mb/s. If it is equal or above (which is easily achieved), then the time for a successful EFC-transaction is below 6ms and this time is in any case enough to complete the transaction even if the distance between the trucks is smaller then 70cm.

TECHNOLOGY REQUIREMENTS

Based on the these necessities the technology should fulfill the following requirements:

DSRC Toll Gates / DSRC-Multi-Lane Gantries:

- The DSRC equipment of the RSE (only microwave because with IR a much faster communication link can be built and the EFC transaction be completed in much shorter time) reads at least the VST of the OBU.
- Systems inside the RSE evaluates such situations by checking the starts of communication links below a time interval depending on the classification of the truck1.
- Systems inside the RSE transmit the data of uncompleted EFC-transactions in such short time intervals to the central systems where they are automatically checked for sequencing beacons and equal transaction counters and ManufacturersIDs.
- If such data is found the transactions of truck1 should be monitored manually and the nearest MEO be alerted to check such situation and initiate the enforcement procedure if the violation can be verified.

Stationary Enforcement Gates (DSRC):

- The DSRC equipment of the RSE (only microwave because with IR a much faster communication link can be

built and the EFC transaction be completed in much shorter time) reads at least the VST of the OBU.

- Systems inside the RSE evaluates such situations by checking the starts of communication links below a time interval depending on the classification of the truck1.
- Laser scanner detects such close “trailing situations without trailing coupling.
- Systems inside the RSE transmits the data of uncompleted EFC-transactions in such short time intervals to the central systems where they are automatically checked for sequencing beacons and equal transaction counters and ManufacturersIDs.
- The combination of the detected RSE data and the laser scanner together with the digital pictures points to violation and the nearest MEO should be alerted for checking the situation and if verified he should initiate the enforcement procedure..

If such data is found the transactions of truck1 should be monitored manually and the nearest MEO be alerted to check such situation and initiate the prosecution if the violation can be verified.

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

The evidence constitution should be performed for

DSRC Toll Gates / DSRC-Multi-Lane Gantries:

- The RSE which receives the VST from the OBU in case the transaction is not completed should store the VST together with the transaction immediately before when the time interval between is below a certain value which depends on the classification of the vehicle in that transaction. These data should be signed by an qualified digital signature to secure against alteration.
- The stored data from this RSE (beacon) should then transmitted to the central enforcement station and stored in a secure storage media and compared with similar data with the focus on the OBU-Configuration data of the incomplete transactions.
- If several matches are found the nearest MEO to the vehicles should be alerted to visually check the situation.
- If the situation is checked and proofed the MEO should take one or more digital pictures from this behavior of the two trucks including the license plates of both trucks for perpetuation of evidence
- The MEO should be legally legitimated to stop both cars and initiate the enforcement procedure.

Stationary Enforcement Gates (DSRC):

- The RSE which receives the VST from the OBU in case the transaction is not completed should store the VST together with the transaction immediately before when the time interval between is below a certain value which depends on the classification of the vehicle in that transaction. These data should be signed by an qualified digital signature to secure the data against alteration.
- The data from the laser scanner for both trucks together with a digital picture from the license plate of the first truck should be stored and signed by a qualified digital signature and combined with the data from the RSE.
- The combined data should be stored in the toll gate on a secure storage medium and protected against unauthorized access.
- The combined data should be transmitted to the central enforcement station and stored on a secure storage

medium and protected against unauthorized access.

- The data should be evaluated manually and compared with similar data from toll gates.
- If matches are found the nearest MEO to this station should be alerted to check and validate the behavior of the two trucks takes one or more digital pictures including the license plate of both trucks for perpetuation of evidence and signed with a qualified digital signature and transmitted to the central enforcement station.

The MEO should be legally legitimated to stop both cars and initiate the enforcement procedure.

TECHNOLOGY REQUIREMENTS

PROCEDURE TO VIOLATION PURSUANCE

The procedure that should be carried through in order to remedy the situation, should be the following, depending on the nationality of the vehicle:

National Vehicles:

- Identification of the violator based on the information read from the OBU and the data registered in the adherents database;
- Notification (via SMS, phone call, letter, registered letter, ...) of the violator to inform about the necessity to remedy the violation. The available notifications include different degrees of reliable service access, for instance a phone call is a more reliable service than a SMS.
- Registry about the violation verified, in order to collect historical data about relapses;
- In case that continued relapse is verified, the owner of the OBU will have to be subject to rescission of the contract, on the basis of its general conditions (for example, after verified x situations of this type);
- In case that the owner of the OBU does not make the necessary efforts to remedy the situation, each country should be free to define what actions should take place.

Non-National Vehicles (inside UE):

- Identification of the origin country of the owner of the OBU through the collection of data registered on the OBU;
- Transmission of data (through a private or public dedicated European network, that should be eNFORCE, defined on the scope of VERA2 report) concerning the evidence of violations to the CI of the contract provider in order he can initiate the process of pursuing the claims of fees and fines. This process must follow the guiding lines described above for national vehicles.

RECOMMENDATIONS

- The probability of the treated situation is very low due to the high risk both trucks have to take and both drivers have to cooperate closely to be successful. Therefore this situation should only be treated if there is a concrete reason to implement the necessary software processes in the system (RSE and OBU and at the central site). Additionally some changes to some already standardized procedures of CARDME and CESARE have to be discussed and performed.

- For lane-constrained systems the installation of high-precision and fast response RSE is critical and should be encouraged in order to make it possible to detect violations as “tailgating” or “piggybacking”. This equipment should be installed even if the EFC system includes lifting bars.

6.3.2.1.23 "Little train" / "Piggybacking" / "Tailgating" (attempt of inhibition of enforcement)

SITUATION	Situation similar to the previous one, but where the only vehicle that has OBU is the one that follows behind. Although activated, the enforcement system will only capture an image of the vehicle which follows behind and when the means of identification of the violator are initiated, it is verified that the OBU belongs to a adherent, not having, therefore, necessity to recover any value. The vehicle of the front will pass, this way, unpunished.

IDENTIFICATION OF THE VIOLATION

MEANS

This situation can only happen if the laser scanner is not independently triggered. If the laser scanner and the license plate recognition is independently triggered (in Austria it scans continually) the described situation can not occur, because each vehicle is recognized and checked and all measures taken in the usual enforcement procedure.

Therefore the defined situation for violation could not happen and is not treated further.

TECHNOLOGY REQUIREMENTS

The system that triggers the video or picture capture system must be independent of the RSE.

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

TECHNOLOGY REQUIREMENTS

PROCEDURE TO VIOLATION PURSUANCE

RECOMMENDATIONS

- The system that triggers the video or picture capture system must be independent of the RSE.
- For lane-constrained systems the installation of high-precision and fast response RSE is critical and should be encouraged in order to make it possible to detect violations as "tailgating" or "piggybacking". This equipment should be installed even if the EFC system includes lifting bars.

6.3.2.1.24 Two vehicles side-by-side (attempt of inhibition of payment)

SITUATION	Situation that occurs when two vehicles (for example, an automobile of passengers and one motorcycle) pass a toll gate or multi-lane gantry side-by-side.

IDENTIFICATION OF THE VIOLATION

MEANS

The DSRC standard (EN1253, 12795 and 12834) correctly implemented provides, that in the communication zone more than three vehicles can communicate with the RSE independently and concurrently. The probability that the OBUs of several vehicles in the same communication zone use the same public uplink window (EN12795 section 7.3 “Window Management”) more than six times in sequence is very low, because this probability follows a Bernoulli distribution and is below $1{,}67 \times 10^{-6.}$ As the time interval for crossing the communication zone even for a speed of 160km/h is at least 300ms and a trial to start the communication link (after it the transaction can be completed) takes about 4 ms there is enough time even at speeds beyond 160km/h to establish and complete the EFC-transaction even for more then one vehicle in the communication zone.

The footprint of the communication zone according to the standard (EN12253 section 5 “DSRC Link Parameters”) is about 8,5m x 3,5m (approximate width of a lane on motorways and 1m above surface (Mounting high of OBU in the vehicle)) . In this footprint fits not more then 6 motorcycles or 4 small cars or one truck. As the cars arrive in sequence even if they do not keep the prescribed security distances, the DSRC-standard gives enough room for completion of the EFC-transactions for all vehicles at speed at 160km/h or even above.

Therefore the defined situation for violation could not happen and is not treated further

TECHNOLOGY REQUIREMENTS

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

TECHNOLOGY REQUIREMENTS

PROCEDURE TO VIOLATION PURSUANCE

RECOMMENDATIONS

6.3.2.1.25 Speed above allowed (attempt of inhibition of payment/enforcement)

SITUATION	Speed above allowed (attempt of inhibition of payment/enforcement). Situations in which one vehicle passes a toll gate or a multi-lane gantry at a speed above of the permissible for the reading by the RSE.

IDENTIFICATION OF THE VIOLATION

MEANS

As already described in the situation before (two vehicles side by side crossing the toll gate) the DSRC-Standard gives enough room to establish and complete an EFC-transaction in the time interval of about 100ms. The total transaction time for an EFC-transaction (according the CARDME-4 Specification) takes about 13ms.

Even for higher speed than 160km/h (time interval for transactions > 60ms) is more than enough room for a complete mandatory EFC-Transaction.

Therefore the defined situation for violation the EFC could not happen. Even for the case that the EFC transaction time is extended due to transferring more data between RSE and OBE enough room is available for the EFC transaction which have the highest priority due to the EN 12834. What is endangerd at very high speed is the transaction time for future services requesting more transaction time. But such transactions generates no violation and enforcement situations. Therefore such situations are not treated further.

TECHNOLOGY REQUIREMENTS

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

TECHNOLOGY REQUIREMENTS

PROCEDURE TO VIOLATION PERSUANCE

RECOMMENDATIONS

6.3.2.1.26 OBU low battery

SITUATION	This situation happens when a vehicle registered with the EETS enters a toll gate or gantry and it cannot perform an EETS transaction due to a shortage in the OBU energy supply. It must be realized that in this case the user may not intend to commit an offense.

IDENTIFICATION OF THE VIOLATION

MEANS

A situation like this must be detected by the RSE at toll gates/gantries or by the portable equipment of the patrol units.
At toll gates/gantries, the incoming vehicle is detected and the RSE should be able to detect that the OBU's battery is low.
When considering mobile enforcement, the same requirements are requested for the equipment installed on the patrol cars.

TECHNOLOGY REQUIREMENTS

Based on the necessities identified in the previous paragraph, technology requirements were determined depending on the enforcement point: toll gates/gantries or patrol-cars.

Toll Gates/Gantries:

- Vehicle detection (loops, laser courtain, radar, etc.);
- DSRC equipment (DSRC beacon) / IR equipment that reads the OBU and understands that the OBU's battery is low.

Mobile enforcement:

- DSRC equipment (DSRC mobile system) that reads the OBU and understands that the OBU's battery is low.

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

The evidence should be built upon the information collected at the toll gate/gantry by electronic means (system log: no-transaction record) associated to a digital photograph. This will be only applicable to enforcement made at toll gates or gantries. When the enforcement is made through mobile means, the vehicle involved in a violation should be stopped in order to regularize the situation. The OBU low-battery condition must be checked and agreed by the driver.

The identification of the violator, in case of dealing with a national vehicle, will be carried out through the search of information concerning the owner of the vehicle in the EETS adherents' database.

In case of dealing with a non-national vehicle, the CI/TSP/EFCO should collect all the relevant information on the offense and then act accordingly (see the entry "Procedure for Violation Regularization for Non-national Vehicles").

TECHNOLOGY REQUIREMENTS

Considering what was stated on the previous entry, evidence of the violation and violator identification will be required only when the enforcement is triggered at toll gates/gantries. In these cases, the technology to install should meet to the following requirements:

Evidence constitution:

- Cameras to capture a digital picture of the vehicle when the violation is taking place (the equipment should be certified in the following capabilities: sensitiveness, accuracy, synchronicity, integrity);
- Systems for automatic license plate recognition;
- Database to record the data related to the violation (time and place, type of incident, license plate number, etc.);
- Encryption for privacy and law compliance (digital signature or watermark).

Identification of violator:

- Black list database (if allowed by national law);
- For national vehicles: access to the national vehicles registry or any other electronic means legally possible (insurance or vehicle technical inspection records);
- For non-national vehicles: means for an effective and reliable handover of the violation information evidence to the CI European network or to the traffic authorities in the corresponding state-member.

PROCEDURE TO VIOLATION PURSUANCE

The procedure to regularize the situation should be as follows, depending on the nationality of the vehicle:

National Vehicles:

- Identification of the vehicle owner.
- Notification of the violation (via sms, phone call, letter, registered letter, etc.) in order to warn the vehicle owner of the necessity to regularize the situation - this notification can assume different degrees of reliability, as the intended level of insistence (for example, a phone call allows a higher reliability degree than a sms). In case the vehicle owner and the driver are not the same person, it would be necessary also to request to the former the driver ID. An extremely well mannered approach is recommended since it is likely that the user may not be aware of the OBU problem.
- The information recorded on the violation must be verified in order to collect historical data about relapses.
- In case that the owner of the vehicle or its driver fail to make the necessary effort to regularize the situation, each country should be free to define what actions should take place, either administrative or jurisdictional.

Non-National Vehicles (inside E.U.):

- Identification of the origin country of the vehicle involved in the violation.
- Sending the related information and evidence on the previously verified violation to the corresponding international CI so that it can initiate the regularization process. This can be done by means of a privately dedicated European network (real or virtual), i.e the eNFORCE network defined on VERA2 report. The process must follow the guidelines described above for national vehicles.
- When the vehicle involved does not belong to the EU the national CI must hand the violation information and evidence over the traffic authorities. If there is a bilateral protocol governing traffic offence information exchange

between both countries the operator must check if it requires any particular action to be taken from its own, otherwise authorities should be able to handle the issue. This case may occur very seldom.

RECOMMENDATIONS

- The use of digital cameras to build violation evidence is strongly recommended as mostly appropriate. It is important to note in this respect that some state-members legislation needs to be reviewed and adapted to this requirement.
- The CIs must keep a database with information concerning national EETS subscribers that allow their identification in case of verification of irregularities (as for example a registered vehicle not being able to interact properly with the roadside equipment). This database should include information on owner identification and contact and must be updated regularly.
- For international violations it is recommended to define the entity in charge to initiate the cross-border procedure for toll recovery. In this respect the state members must agree the procedure for the recovery of the ammounts indebted by non-national citizens to national CIs.
- It is also recommended to use a dedicated communications network (real or virtual) for enforcement that can be shared on a cost-effective basis by different EETS players. This network must include all systems, applications. documents and procedures needed for information exchange. The eNFORCE network defined in the VERA2 report can be considered as a model.
- Finally, it is interesting to assess the feasibility of a regulatory/certification European organization entitled to address all issues regarding enforcement legal procedures, international relations between EETS players, etc.

6.3.2.1.27 OBU with no valid contract

SITUATION	This situation occurs when a vehicle is equipped with an OBU but there is no valid contract registered in the system.

IDENTIFICATION OF THE VIOLATION

MEANS

To identify this situation, the RSE or the mobile enforcement team should be able to detect a vehicle with an OBU. However, after reading the information recorded in the OBU and the information present in the central system, it verifies that there is no valid contract for that OBU, since it was expired or it was rescinded or the CI is not recognized in the interoperability system.

TECHNOLOGY REQUIREMENTS

The technology requirements for the identification of the situation are:

Toll gates/gantries:

- Equipment for automatic vehicle detection (as tri-dimensional scanners, loops, pressure detectors, …)
- DSRC equipment to read the information stored in the OBU;
- Interface with a database containing updated information regarding all OBUs that do not have a valid contract in the interoperable system.

Mobile enforcement:

- DSRC portable equipment;
- Interface with a database containing updated information regarding all OBUs that do not have a valid contract in the interoperable system.

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

At toll gates/gantries and in order to constitute evidence of the violation it is necessary to capture a picture/image of the violation (vehicle passing the toll gate/gantry), with information attached about the local and time of the violation.
When dealing with a national citizen, it should be searched in the central database the information about the correspondent contract. If that contract is not valid (expired or rescinded), the owner's contact data must be retrieved and the user should be notified.
When dealing with a non-national citizen, all the data collect about the violation and the vehicle must be sent to the correspondent CI, which should then initiate the procedure to regularize the situation.

When the enforcement is made through patrol cars, it should be promoted the immediate stopping of the vehicle and the clarification of the situation, identifying the driver and/or the OBU owner, being this procedure the evidence of the

violation.

TECHNOLOGY REQUIREMENTS

The technical requirements to constitute evidence of the violation are only applicable to the enforcement made on the toll gates/gantries. In this case, the technology to install should fulfill to the following needs:

Evidence constitution:

- Equipment to capture pictures/images of the vehicle in violation (these should be certified in what concerns the timestamp of the violation and non manipulation of data attached to the photograph);
- Systems to automatic license plate recognition;
- Database to collect all information related with this type of violation (time and place information, license plate number, …).

Identification of the violator:

- Database with information of the adherents of the system, including identification and contacts of the owner of the OBUs (phone number, address, …) and information about the contract;
- Global lists that should be created by the CI of each country, with information of the expired/rescinded contracts with the users. These databases should have periodical updates and should be distributed among all TSP/EFCO/CI in the EFC system;
- Privileged communication channels in order to have a high level of information sharing and considering to use the eNFORCE network resulting from the VERA2 project;
- System that correlates the information of the OBU owner with the data collected about the violation, producing a report that will support the debt recovery process;
- If the violation occurs with frequency for the same OBU owner, it should be recorded all the violations and owner's identification in a list ("black-list") that should be available for all EETS actors.

PROCEDURE TO VIOLATION PURSUANCE

The procedures to implement with the objective to regularize this situation should be:

- Identification of the OBU owner's country, made through the reading of the information registered in the OBU or through the pictures/images captured with license plate recognition;
- Sending of information (through a private dedicated European network, that should be eNFORCE, defined on the scope of VERA2 report) of the violation and the respective evidences to the actual Contract Issuer of the OBU owner (in case of a CI not recognized in the interoperable system) or to the previous Contract Issuer of the OBU owner (in case of a expired/rescinded contract with the CI) that should be an assistant entity in the process of the identification of the OBU owner, in order to facilitate the collection of the fee.

[*The Expert Group 10 should also define the rules to be applied to the citizens from countries outside the EU (by establishing transversal rules to be applied to any outsider country or by allowing the definition of bilateral agreements to be made when necessary)*]

RECOMMENDATIONS

- It should be promoted the use of pictures/images for constitution of evidence of the violations. In this direction, the legislation in some of the state-members will have to be reviewed so that it could be adapted to this requirement.
- All Contract Issuers must keep databases to register information concerning the adherents that allow their identification in case of violations. These databases must be regularly updated and should include the identification and contacts of the adherents. It should be also created a black-list of all expired/rescinded contracts.
- It should be defined which entity has the responsibility to initiate the regularization procedure for this type of violations. In this scope, the state members must discuss and define what should be the procedure for the recovery of values in debt by OBU owner with no valid contract (how the debt will be paid to the TSP/EFCO of the country where the violation took place).
- It should be promoted the use of a private and dedicated network for communication between the different EETS actors. This network must include systems, applications and templates of documents and procedures so that the sharing of information could be effectively done. In this scope, should be used the eNFORCE network, defined in the VERA2 report.
- A regulatory/certification european agency should be set up to address issues related to legal procedures, relationships between EETS actors, etc..
- It should be defined procedures for certification of the equipment used for picture/image capture of the violation (certification of the reliability of the image, of the license plate recognition, of the time and place attached data,…).

6.3.2.1.28 OBU software or Data not up to date or invalid

SITUATION	This situation occurs when a vehicle is equipped with an OBU but invalid/outdated Software or Data (e.g. Geo Data, Tariff Data, …) prevent correct functioning of OBU.

IDENTIFICATION OF THE VIOLATION

MEANS

To identify this situation, internal Mechanisms in the OBU keep track of validity and integrity of all software and relevant data in the OBU. If any of these becomes invalid, e.g. because it's end of validity date is reached and no update could be obtained or if an integrity check failed, the OBU will signal an error to the user, who will then need to take remedial action. The RSE or the mobile enforcement team should be able to detect a vehicle with an OBU in this error stage.

TECHNOLOGY REQUIREMENTS

The technology requirements for the identification of the situation are:

Toll gates/gantries:

- Equipment for automatic vehicle detection (as tri-dimensional scanners, loops, pressure detectors, …)
- DSRC equipment to read the information stored in the OBU;
- Interface with a database containing updated information regarding all OBUs

Mobile enforcement:

- DSRC portable equipment;
- Interface with a database containing updated information regarding all OBUs

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

At toll gates/gantries and in order to constitute evidence of the violation it is necessary to capture a picture/image of the violation (vehicle passing the toll gate/gantry), with information attached about the local and time of the violation.
When dealing with a national citizen, it should be searched in the central database the information about the correspondent contract. and the user should be notified about the remedial action to take.
If there is an alternative way for payment (e.g. a booking system [pre-booking or post-booking]), correct payment using this alternative means has to be checked before further enforcement action is taken. Once a violation is evident, the following procedures should be taken.

When dealing with a non-national citizen, all the data collect about the violation and the vehicle must be sent to the correspondent CI, which should then initiate the procedure to regularize the situation.

When the enforcement is made through patrol cars, it should be promoted the immediate stopping of the vehicle and

the clarification of the situation, identifying the driver and/or the OBU owner, being this procedure the evidence of the violation.

TECHNOLOGY REQUIREMENTS

The technical requirements to constitute evidence of the violation are only applicable to the enforcement made on the toll gates/gantries. In this case, the technology to install should fulfill to the following needs:

Evidence constitution:

- Equipment to capture pictures/images of the vehicle in violation (these should be certified in what concerns the timestamp of the violation and non manipulation of data attached to the photograph);
- Systems to automatic license plate recognition;
- Database to collect all information related with this type of violation (time and place information, license plate number, …).

Identification of the violator:

- Database with information of the adherents of the system, including identification and contacts of the owner of the OBUs (phone number, address, …) and information about the contract;
- Global lists that should be created by the CI of each country, with information of the expired/rescinded contracts with the users. These databases should have periodical updates and should be distributed among all TSP/EFCO/CI in the EFC system;
- Privileged communication channels in order to have a high level of information sharing and considering to use the eNFORCE network resulting from the VERA2 project;
- System that correlates the information of the OBU owner with the data collected about the violation, producing a report that will support the debt recovery process;
- If the violation occurs with frequency for the same OBU owner, it should be recorded all the violations and owner's identification in a list ("black-list") that should be available for all EETS actors.

PROCEDURE TO VIOLATION PURSUANCE

The procedures to implement with the objective to regularize this situation should be:

- Identification of the OBU owner's country, made through the reading of the information registered in the OBU or through the pictures/images captured with license plate recognition;
- Sending of information (through a private dedicated European network, that should be eNFORCE, defined on the scope of VERA2 report) of the violation and the respective evidences to the actual Contract Issuer of the OBU owner (in case of a CI not recognized in the interoperable system) or to the previous Contract Issuer of the OBU owner (in case of a expired/rescinded contract with the CI) that should be an assistant entity in the process of the identification of the OBU owner, in order to facilitate the collection of the fee.

[*The Expert Group 10 should also define the rules to be applied to the citizens from countries outside the EU (by establishing transversal rules to be applied to any outsider country or by allowing the definition of bilateral agreements to be made when necessary)*]

RECOMMENDATIONS

- It should be promoted the use of pictures/images for constitution of evidence of the violations. In this direction, the legislation in some of the state-members will have to be reviewed so that it could be adapted to this requirement.
- All Contract Issuers must keep databases to register information concerning the adherents that allow their identification in case of violations. These databases must be regularly updated and should include the identification and contacts of the adherents. It should be also created a black-list of all expired/rescinded contracts.
- It should be defined which entity has the responsibility to initiate the regularization procedure for this type of violations. In this scope, the state members must discuss and define what should be the procedure for the recovery of values in debt by OBU owner with no valid contract (how the debt will be paid to the TSP/EFCO of the country where the violation took place).
- It should be promoted the use of a private and dedicated network for communication between the different EETS actors. This network must include systems, applications and templates of documents and procedures so that the sharing of information could be effectively done. In this scope, should be used the eNFORCE network, defined in the VERA2 report.
- A regulatory/certification european agency should be set up to address issues related to legal procedures, relationships between EETS actors, etc..
- It should be defined procedures for certification of the equipment used for picture/image capture of the violation (certification of the reliability of the image, of the license plate recognition, of the time and place attached data,…).

6.3.2.1.29 OBU identified in the black list

SITUATION	Situation that occurs when a vehicle whose OBU is registered in a "black list" passes a toll gate (in a barrier less system) or other enforcement point.

IDENTIFICATION OF THE VIOLATION

MEANS

In order to this situation to take place it is necessary that, at the check-point, the road side equipment detects a vehicle passing through, the DSRC beacon reads the OBU installed in the vehicle and verifies that is an OBU (or the contract established with the Issuer, that is associated with this OBU) recorded in the "black-list" (for example, a client with an irregular bank account situation, or amounts in debt to the Issuer, or to many low battery warnings without any action to change it, …) of the EFC system. In this case, the equipment for image capture should be triggered and a picture/image should be taken and stored for future analysis.

This situation is also possible to be detected during a mobile enforcement operation when the enforcement team detects a vehicle with an OBU (or the contract established with the Issuer, that is associated with this OBU) that is recorded in the "black-list" of the EFC system.

TECHNOLOGY REQUIREMENTS

The recommended technology requirements must be determined depending on the enforcement point: toll gates / multi-lane gantries or mobile patrol units.

Toll Gates / Multi-lane Gantries

In this case, the technology requirements that should be guaranteed are:

- Equipment for automatic vehicle detection (as tri-dimensional scanners, loops, pressure detectors,…)
- DSRC equipment (DSRC *beacon*) to detect / read the OBU
- Equipment for image capture and license plate recognition system
- Database with updated information regarding all OBU (or contracts established with the Issuer) that are classified in the "black list"

Mobile patrol units:

If we consider the enforcement made by the patrol-cars, the technology requirements are:

- DSRC portable equipment (DSRC *mobile system*) to detect/read the OBU
- Mobile communication means to access the remote database of all OBU (or contracts established with the Issuer) that are classified in the "black list"

For this purpose, it is crucial that all issuers frequently send their "black lists" to the TSPs in order to determine, based on the time of the violation and the last update version of the database, which entity (TSP/EFCO/Issuer) has to assume the responsibility of the lost revenue.

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

In order to have evidence of this situation it is necessary to have an image of the vehicle which has an OBU that is included in the "black list" of the EFC system. Then, the DSRC system reads the OBU and verifies that it is classified in the "black list" and an image of the vehicle is taken at that moment, with certified metadata (such as license plate recognition outcome, the location and date, …). The license plate number is recognized through a back office procedure, more or less automated.

To identify the OBU owner it is necessary to search in the database that contains all the information about the OBUs included in the "black list" (such as owner identification and personal contacts). This database should be up-to-date.

When the enforcement is made through mobile patrol units, it should be defined by the EETS actors if the vehicle in violation should be stopped in the nearest possible site (rest park, gas station, …) by the mobile patrol units and the vehicle's driver/owner should be identified at that moment (the identification can be checked by comparing with the information included in the "black list").

TECHNOLOGY REQUIREMENTS

The technology requirements for the evidence of this situation and for the identification of the vehicle's owner are:

Evidence constitution:

- Image capture equipment (this should be certified in what concerns the timestamp and non manipulation of data attached to the photograph)
- Automatic license plate recognition system
- Database with information of all OBU included in the "black list"

Identification of the OBU's owner :

- Database to support the information contained in the "black list"
- System that searches in this database the identification of the OBU's owner
- Fixed or mobile communication means to access the remote database

PROCEDURE TO VIOLATION PURSUANCE

The procedure that should be carried through in order to regularize the situation is the following, depending on the kind of enforcement point and on the physical equipment installed:
Toll gate with physical barriers:

- In this case, the vehicle should be directed to a manual lane in order to pay the respective toll/fee.

Toll gate with no physical barriers or multi-lane:

- In this case, it should be registered that violation as a No OBU situation.

Mobile patrols:

- In this case, the mobile patrol unit should promote the stop of the vehicle (if the EETS actors established this procedure) and confirm the identification of the OBU's owner. The situation should be clarified on the spot and, if confirmed that the vehicle has an OBU included in the "black list", the vehicle should be escorted to the nearest exit (if possible, it should be considered the possibility of the vehicle continue the trip but after the situation has been regularized).

In any of the enforcement points types stated above, and depending on the policy of each TSP/Issuer, it should be defined if there is the need for the application of a penalty or if there is only the appliance of the normal tariff.
by the other hand, this situation should be registered in a database that supports the "black list" in order to collect historical information for future analyses.

RECOMMENDATIONS

- The Issuers should create and maintain "black lists" with updated information about users that consistently commit violations or aggravated fraud against the EETS and send it to the TSP – the rules for the inclusion of these users in the "black lists" should be discussed and approved by the state-members and, if necessary, some national legislation should be adapted in order to implement the approved solution. For this purpose, the EETS actors should evaluate if a EFC contract becomes classified in the "black list" due to one specific OBU, the others OBUs that may be associated to this contract will also be considered in the "black list".
- The CI must keep databases to register information concerning the adherents of the EFC system, which allow their identification in case of violations. These databases must regularly be updated and should include information on identification and contacts of the adherents.
- The CI should create and maintain "grey-lists" with information about users that have propensity to violate – the rules for the inclusion of these users in these lists should also be discussed and approved by the state-members and, if necessary, some national legislation should be adapted in order to implement the approved solution.
- It should be promoted the use of images for the constitution of evidence of the violations. So, maybe it will be necessary to adapt the national legislation of some state-members in order to implement this recommendation. Some aspects to consider are:
    - The possibility to capture of images from the front-end or from the rear-end or from both ends of the vehicle;
    - The possibility to archive all images or only of the irregular / violation situations;
    - The possibility to record and archive panoramic images of vehicles in situation of violation (and not only those which capture only the licence plate);
    - The possibility to record and archive a panoramic image of the passing vehicle with the recognition of the license plate;
    - The certification of the data attached to the photographs (for example, time &place information);
    - Other situation that might be considered.
- It should be promoted the use of a private and dedicated network for communication between the different EETS actors. This network must include systems, applications and templates of documents and procedures so that the sharing of information could be effectively done. For this purpose, the use of the eNFORCE network, defined in the VERA2 report, could be proposed.
- A regulatory/certification European agency should be set up to address issues related to legal procedures, relationships between EETS actors, etc. .
- It should be considered a fixed and non-removable installation of the OBUs to vehicles, in order to avoid some

irregular / violation situations.

- The reliability of the EETS is dependent of the fact that all accepted EETS actors comply with a basic set of rules. The acceptance minimum requirements shall be part of a MoU.
- It should be defined by the EETS actors a period for the user to regularize the situation and after that the Issuer has the possibility to rescind the contract.

6.3.2.1.30 OBU with video flag on

SITUATION	Situation that occurs when a vehicle, whose OBU wanted flag is set on, passes a toll gate or other enforcement point. In these cases a picture of that vehicle has to be taken in any case.

IDENTIFICATION OF THE VIOLATION

MEANS

The identification of this situation occurs when a vehicle is passing at one check-point (toll gate or multilane gantries) and the RSE detects that the "video flag" stored in the OBE is set. The RSE initiates that the video system takes a picture of that vehicle and stores it in a secure storage medium together with the data stored in the OBE and the time, location and license plate information.

It is also possible that during a mobile enforcement operation, the DSRC portable equipment carried by the enforcement team detects that the OBU has the status video flag on.

TECHNOLOGY REQUIREMENTS

Based on the necessities identified in the previous paragraph, technology requirements must be determined depending on the enforcement point: toll gates and multi-lane gantries or patrol-cars.

Toll Gates / Multi-lane Gantries:

In this case, the technology requirements to be considered are:

- DSRC equipment (DSRC beacon) / IR equipment to read the information stored on the OBU.
- Equipment to capture images (photos or videos, with or without infrared flash, with or without ALPR system) of the vehicle in the passing points (entrance and exit).

Mobile enforcement:

When the enforcement is made by patrol-cars, the technology requirements are:

- DSRC equipment (DSRC mobile system) to read the information stored on the OBU.
- Equipment to capture images (photos or videos, with or without infrared flash) of the vehicle.

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

The evidence should be built upon the information collected at the toll gate/gantry by electronic means (system log: no-transaction or wrong transaction record) associated to a digital photograph. This will be only applicable to enforcement made at toll gates or multi-lane gantries. When the enforcement is made through mobile means, the vehicle involved in the violation should be stopped in order to regularize the situation.

When the enforcement is triggered at the toll gates or multi-lane gantries, the identification of the violator (vehicle with a

national plate), will be carried out in two consecutive steps:

1) Through the search of information concerning the owner of the vehicle in the adherents' database;
2) If it happens that the vehicle is not registered with the EFC system, the information must be retrieved from external sources as indicated in the entry ("Technology requirements – Identification of Violator").

In case of dealing with a non-national vehicle, the TSP/EFCO should record all the relevant information on the offense and send it to the CI with which the contract has been established. This CI must then initiate the recovery process, as if it was a national vehicle.

6.3.2.1.31 OBU with tampering flag on

SITUATION	This situation happens when a vehicle registered with the EETS enters a designated toll gate or gantry but it cannot perform an EETS transaction due to a malicious alteration of the OBU. It must be realized that in this case the user may deliberately intend to commit an offense or even a fraud.

IDENTIFICATION OF THE VIOLATION

MEANS

The identification of this situation occurs when a vehicle is passing at one check-point (toll gate or multilane gantries) and the DSRC system detects that the OBU was violated or there was an attempt to do it (tampering status on). Then the image capture equipment is trigged and a picture/image is taken and stored for future analyse.

It is also possible that during a mobile enforcement operation, the DSRC portable equipment carried by the enforcement team detects that the OBU has the status tampering flag on.

TECHNOLOGY REQUIREMENTS

Based on the necessities identified in the previous paragraph, technology requirements must be determined depending on the enforcement point: toll gates and multi-lane gantries or patrol-cars.

Toll Gates / Multi-lane Gantries:

In this case, the technology requirements to be considered are:

- Vehicle detection (loops, laser courtain, radar, etc.);
- DSRC equipment (DSRC beacon) / IR equipment to read the information stored on the OBU.

Mobile enforcement:

When the enforcement is made by patrol-cars, the technology requirements are:

- DSRC equipment (DSRC mobile system) to read the information stored on the OBU.

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

The evidence should be built upon the information collected at the toll gate/gantry by electronic means (system log: no-transaction or wrong transaction record) associated to a digital photograph. This will be only applicable to enforcement made at toll gates or multi-lane gantries. When the enforcement is made through mobile means, the vehicle involved in the violation should be stopped in order to regularize the situation. The OBU malfunction must be checked and agreed by the driver.

When the enforcement is triggered at the toll gates or multi-lane gantries, the identification of the violator (vehicle with a

national plate), will be carried out in two consecutive steps:

3) Through the search of information concerning the owner of the vehicle in the adherents' database;
4) If it happens that the vehicle is not registered with the EFC system, the information must be retrieved from external sources as indicated in the entry ("Technology requirements – Identificacion of Violator").

In case of dealing with a non-national vehicle, the TSP/EFCO should record all the relevant information on the offense and send it to the CI with which the contract has been established. This CI must then initiate the recovery process, as if it was a national vehicle.

TECHNOLOGY REQUIREMENTS

Considering what was stated on the previous entry, evidence of the violation and violator identification will be required only when the enforcement is triggered at the toll gates or multi-lane gantries. In these cases, the technology to install should meet to the following requirements:

Evidence constitution:

- Cameras for capture a digital picture at the time of the violation (the equipment should be certified in the following capabilities: sensitiveness, accuracy, synchronicity, integrity);
- Systems for automatic license plate recognition;
- Database to record the data related to the violation (time and place, type of incident, license plate number, etc.);
- Encryption for privacy and law compliance (digital signature or watermark).

Identification of violator:

- For national vehicles: access to the national registry database or any other electronic means legally possible (insurance or vehicle technical inspection records).
- For foreign vehicles: means for an effective and reliable handover of the violation information evidence to the CI European network or to the traffic authorities in the corresponding state-member.

PROCEDURE TO VIOLATION PURSUANCE

The procedure to regularize the situation should be as follows, depending on the nationality of the vehicle:

National Vehicles:

- Identification of the vehicle owner;
- Notification of the violation (via sms, phone call, letter, registered letter, etc.) in order to warn the vehicle owner of the necessity to regularize the situation - this notification can assume different degrees of reliability, as the intended level of insistence (for example, a phone call allows a higher reliability degree than a sms). In case the vehicle owner and the driver are not the same person, it would be necessary also to request to the former the driver ID. An executive approach is recommended since it is likely that the user may intend to defraud the toll system;
- The information recorded on the violation must be verified in order to collect historical data about relapses.
- In case that the owner of the vehicle or its driver fail to make the necessary effort to regularize the situation, each country should be free to define what actions should take place, either administrative or jurisdictional.

Non-National Vehicles (inside UE):

- Identification of the origin country of the vehicle involved in the violation.
- Sending the related information and evidence on the previously verified violation to the corresponding international CI so that it can initiate the regularization process. This can be done by means of a privately dedicated European network (real or virtual), i.e the eNFORCE network defined on VERA2 report. The process must follow the guidelines described above for national vehicles.
- When the vehicle involved does not belong to the EU the national CI must hand the violation information and evidence over the traffic authorities. If there is a bilateral protocol governing traffic offence information exchange between both countries the operator must check if it requires any particular action to be taken from its own, otherwise authorities should be able to handle the issue.

RECOMMENDATIONS

- The use of digital cameras to build violation evidence is strongly recommended as mostly appropriate. It is important to note in this respect that some state-members legislation needs to be reviewed and adapted to this requirement.
- The CIs must keep a database with information concerning national EETS subscribers that allow their identification in case of verification of irregularities (as for example a registered vehicle not being able to interact properly with the roadside equipment). This database should include information on owner identification and contact and must be updated regularly.
- For international violations it is recommended to define the entity in charge to initiate the cross-border procedure for toll recovery. In this respect the state members must agree the procedure for the recovery of the amounts indebted by non-national citizens to national CIs.
- It is also recommended to use a dedicated communications network (real or virtual) for enforcement that can be shared on a cost-effective basis by different EETS players. This network must include all systems, applications, documents and procedures needed for information exchange. The eNFORCE network defined in the VERA2 report can be considered as a model.
- Finally, it is interesting to assess the feasibility of a regulatory/certification European organization entitled to address all issues regarding enforcement legal procedures, international relations between EETS players, etc.

6.3.2.1.32 OBU not Supporting the RSE Enforcement Protocols

SITUATION	This situation occurs when an OBU does not support the RSE enforcement protocols (or it supports it but not the correct version) restricting the enforcement capabilities of the road service provider to the OBUless case (e.g, photograph, visual inspection, etc).

IDENTIFICATION OF THE VIOLATION

MEANS

A situation like this should be detected by the DSRC/IR roadside equipment (in systems that include toll gates or gantries for tolling enforcement) or by patrol units (in systems that include this kind of enforcement).

In what concerns the road-side equipment-based enforcement, the identification of the violation should be done as follows:

The incoming vehicle is detected

The RSE initiates a data readout from OBU for enforcement purpose

The information gathered indicates that the OBU is inactive or not working properly

If the enforcement is done by patrol units, the enforcement team should have the needed equipment in order to detect the presence (or not) of an OBU installed in the vehicle.

TECHNOLOGY REQUIREMENTS

The recommended technology requirements are determined by the type of enforcement point: toll gates / enforcement gantries or patrol units.

Toll Gates / Multi-lane Gantries:

In this case, the technology requirements that should be guaranteed are:

- Equipment for automatic vehicle detection (as tri-dimensional scanners, loops, pressure detectors,…);
- DSRC/CALM equipment (DSRC/CALM *beacon*) to read/detect the OBU.

Patrol Units:

If we consider the enforcement made by the patrol-cars, the technology requirements are:

- DSRC/CALM portable equipment (DSRC/CALM *mobile system*) to read/detect the OBU.

EVIDENCE CONSTITUTION AND VIOLATOR IDENTIFICATION

MEANS

It must be determined whether the enforcement system has detected a violator, or a driver with low-cost/outdated EETS OBU, which is incompatible with the actual enforcement infrastructure. In the second case the driver must have been

aware of having to pre-book his route via the pre-booking system.

The identification of the violator (vehicle with a national plate), will be carried out in three consecutive steps:

1) The RSE shall query from back-office whether the driver is on a pre-booked route. Following steps shall be taken only in case that current route has not been pre-registered
2) Through the search of information concerning the owner of the vehicle in the EETS adherents' database; the CI should be able to look it up, accessing the information needed about registered vehicles and their owners.
3) If it happens that the vehicle is not registered with the EETS, the information must be retrieved from external sources as indicated in the entry "Technology Requirements – Identification of Violator".

In case of dealing with a non-national vehicle, the CI/TSP/EFCO should collect all violation's evidences and use international communication networks (see "Technology Requirements - Identification of Violator") in order to solve the situation with the CI of the country identified by reading the license plate.

TECHNOLOGY REQUIREMENTS

Considering what was stated on the previous entry, evidence of the violation and violator ID will be required only when the enforcement is triggered at the toll gates or multi-lane gantries. In these cases, the technology to install should meet to the following needs:

Evidence constitution:

- Image capture equipment (the equipment should be certified in the following capabilities: sensitiveness, accuracy, synchronicity, integrity);
- Systems for automatic license plate recognition;
- Database to collect data related to the violation (time and place information, license plate number, information gathered from OBU,…);
- Encryption for privacy and law compliance (digital signature or watermark).

Identification of violator:

- Black list database (if allowed by national law);
- For national vehicles: access to the national register or any other electronic means legally possible (insurance or vehicle technical inspection records);
- For non-national vehicles: means for an effective and reliable handover of the violation information evidence to the CI European network or to the traffic authorities in the corresponding state-member.

PROCEDURE TO VIOLATION PURSUANCE

The procedure to regularize the situation should be as follows, depending on the nationality of the vehicle:

National Vehicles:

- Identification of the vehicle owner;
- Notification of the violation (via sms, phone call, letter, registered letter, etc.) in order to warn the vehicle owner of the

necessity to regularize the situation - this notification can assume different degrees of reliability, as the intended level of insistence (for example, a phone call allows a higher reliability degree than a sms). In case the vehicle owner and the driver are not the same person, it would be necessary also to request from the former the driver ID;

- The information recorded on the violation must be verified in order to collect historical data about relapses;
- In case that the owner of the vehicle or its driver fail to make the necessary effort to regularize the situation, each country should be free to define what actions should take place, either administrative or jurisdictional.

Non-National Vehicles (inside UE):

- Identification of the origin country of the vehicle involved in the violation;
- Sending the related information and evidence on the previously verified violation to the corresponding international CI so that it can initiate the regularization process. This can be done by means of a privately dedicated European network (real or virtual), i.e the eNFORCE network defined on VERA2 report. The process must follow the guidelines described above for national vehicles.
- When the vehicle involved does not belong to the EU the national CI must hand the violation information and evidence over the traffic authorities. If there is a bilateral protocol governing traffic offence information exchange between both countries the operator must check if it requires any particular action to be taken from its own, otherwise authorities should be able to handle the issue.

RECOMMENDATIONS

For preventing such violation, possible OBU incompatibilities should be kept to minimum:

- Different countries' enforcement systems should be able to communicate with as many EETS OBUs as practically feasible
- It is desired that enforcement communications interface uses future-proof technology, so that as few incompatible updates are required as practically feasible

Therefore the recommendation is to promote EETS OBU with advanced enforcement interfaces (a combination of currently existing enforcement communication technologies).

6.4 Technology Analysis

This document aims at describing and comparing state of the art in free-flow multi-lane and single-lane tolling enforcement technologies having in mind the European Directive 2004/52/EC that deals with the interoperability of electronic road toll systems in the Community. The description covers both system architecture and technologies aspects.

First, the building blocks of an enforcement system are illustrated. Next, those interfaces are described in detail, where comparable enforcement technologies exist. Based on results of these comparisons, cost efficiencies of possible combinations are compared in various specific toll concession layouts.

The current work offers alternative enforcement technologies that can all support the EETS service and recognizes the national legal frameworks as well as the right of each operator to enforce by an appropriate method of his choice following an appropriate set of rules and procedures. EG10 is also very conscious that most tolling services in Europe currently operate on mono-lane schemes with barrier control and that a cost-effective, acceptable by all operators solution must be found towards free-flow. Examples of multi-lane high speed free flow enforcement are currently in operation in Austria and Germany.

While it is possible to verify correct adherence to a tolling scheme at well-defined toll points in classic tolling systems, this is not possible in full free-flow systems covering an open road network. In classical tolling systems, the obligation to pay is established, charged, verified and enforced at well-defined road points, where specific infrastructure on the road side for all of these tasks exist, including lifting barriers that stay closed until the obligation for payment has been fulfilled. In this sense, the full road network is covered - both with respect to charging and to enforcement and a 100% check is done.

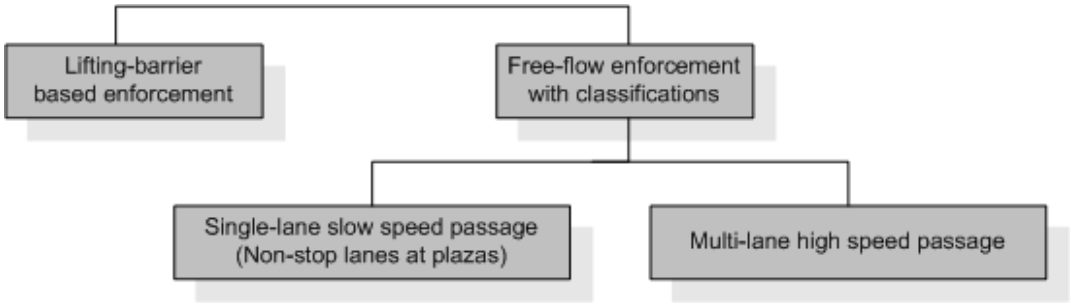
In full-speed, multilane free-flow scenarios covering open road networks and where charging relies on on-board equipment, the situation is very different. In this case, correct use and function of the OBU is the basis for charging - and thus to be verified as the first step of enforcement. Since one of the main reasons for installing free-flow tolling systems is to avoid any negative impact on traffic, stopping traffic for the purpose of checking the correct use and function of the OBU is not acceptable - this needs to be done also in a free-flow mode. For such open road networks without barriers, there is no viable way to achieve a 100% check as in the classic case, also leading to another enforcement paradigm: Check only a certain statistical sample of the traffic but if non-compliance is detected, a penalty or fine will apply, so that non-compliance will not give the violator any advantage on the long run. This is a very well established enforcement scheme also in other fields, e.g. bus, subway, train and other tickets. However, it is obvious that this can only be effective, if such checks must be expected anywhere at any time, so that no patterns can be applied that limit the risk of being caused considerably.

Before identifying and characterizing enforcement technologies, it is necessary to understand how European enforcement systems for tolling are implemented.

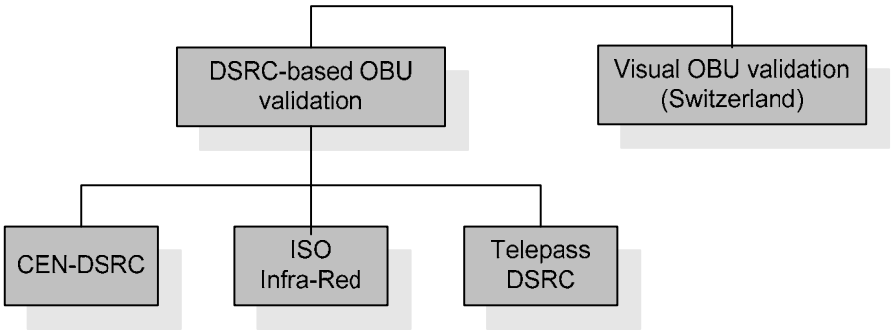
6.4.1 ENFORCEMENT SYSTEMS CLASSIFICATION

As provided by the Functional Specification, enforcement systems for tolling can be categorized by the following criteria:

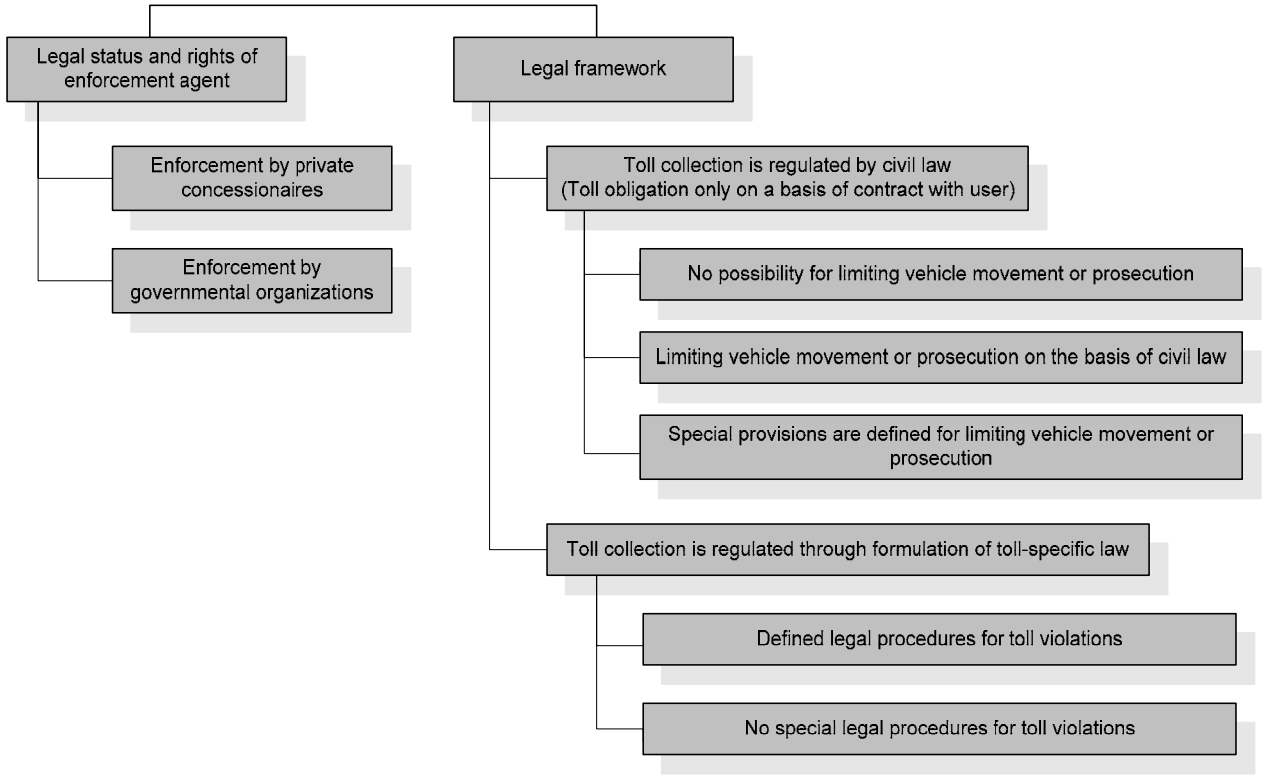
- **By physical barrier presence**:



- **By On-Board Unit enforcement interface type:**

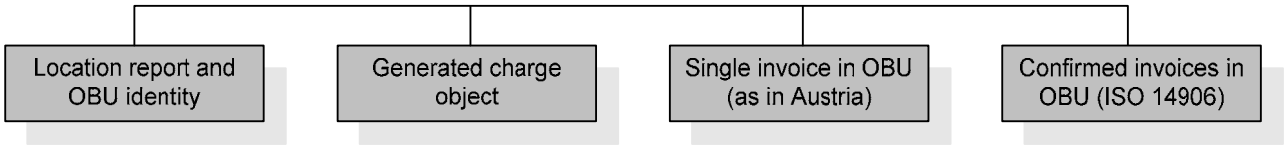


- **By relating legal regulations:**

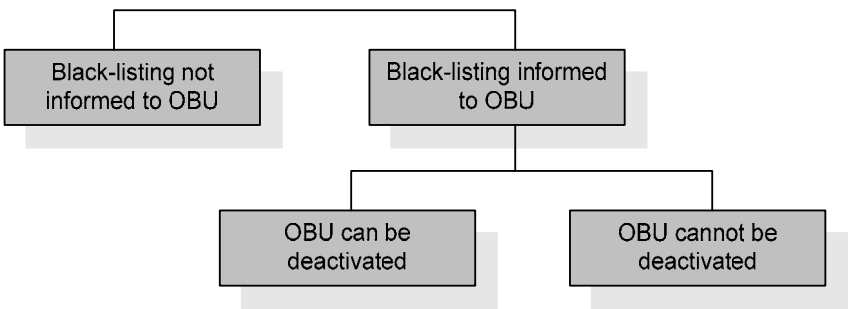


- **By charging data generated (based on sophistication level of accounting inside the OBU):**

During the enforcement process, such data types must be read out from OBU for validation purpose (the data length is approximately 350 bytes in the most sophisticated case):

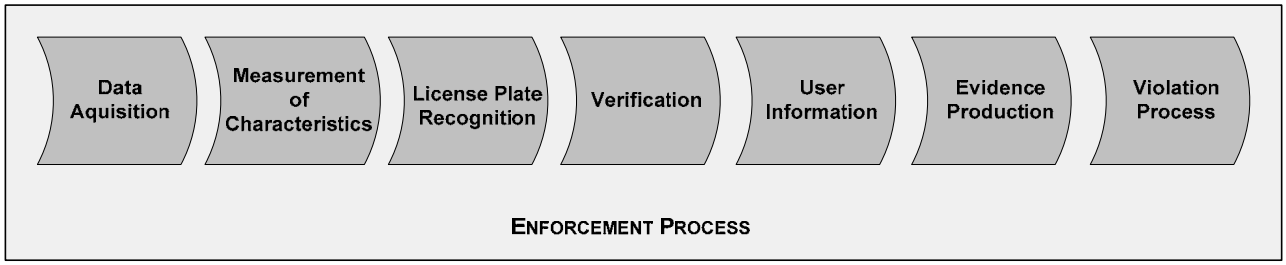


- **By the type of "black-list" management:**



6.4.2 THE ENFORCEMENT PROCESS

While above-described categories cause differences during enforcement execution, the overall process flow is generic. The enforcement process can be described as progression through following steps:



Each of the phases included on this process could be described in the following way:

- **Data Acquisition:**

Information about which vehicles on the road are eligible for tolling must be acquired. This may be obtained via dedicated wireless communications from road-side equipment, by querying a database, white list, etc at the road-side or on the back-end side. The information content ranges from location and identity report in the simple OBU accounting case to the confirmed invoices in the sophisticated OBU accounting case. A confirmed invoice is an electronic certificate of toll payment. This information may also include details of the expected characteristics of the vehicle in question, including user declared parameters and OBU status information and logs. The utilized technology for dedicated data acquisition varies with the data types to be acquired. Future trend points to exchange of more data content, therefore reliable data readout will become ever more important.

For data acquisition in multilane free-flow environments of open networks, two basic principles have been invented:

- static enforcement using enforcement gantries at well suited, but fixed position
- mobile enforcement using vehicles and portable enforcement using small, easy to transport equipment that allow enforcement anywhere on the road network at any time

It is obvious, that static enforcement locations are well known after a short time. It would thus be possible to invent some scenarios, in which correct payment is done only where enforcement is present, but not elsewhere. To avoid this, mobile / portable enforcement is needed that can cover the whole road network - anywhere at anytime, so that no predictable scenario can be developed by a potential fraudster that would allow him to be safe.

In both cases, the first step (i.e. checking a moving vehicle for compliance with the scheme) is done without stopping the vehicle by reading an enforcement record from the OBU and by checking the OBU's settings of declared parameters. Only if there is an indication of non-compliance or malfunction, further action possibly including stopping the vehicle will be initiated in subsequent enforcement steps.

- **Measurement of Characteristics:**

Measuring the vehicle characteristics is a 'traditional' process to determine the vehicle class in the multi or mono lane system. Of the many different characteristics that can be used to determine the class of a vehicle (examples can be found at the claimed vehicle characteristics included in CEN TC278), only some will be measurable in a free flow environment[1]. Any measured characteristics will be passed to the verification phase to compare them with the information obtained from the data acquisition process.

- **License Plate Recognition:**

Although optionally implemented, this enforcement sub-function provides (with some confidence level) the license plate of the passing vehicle, given the image acquired. This sub-function inherently serves both the verification process that follows (e.g. look-up in an authoritative database for true registered vehicle characteristics) and the evidence production process.

- **Verification:**

Measured characteristics must be compared with any data acquisition information to verify that a particular vehicle has completed a valid transaction. For the reliability of this step, it is important to ensure that the OBU is based on secure schemes and key management against manipulation. Back-office internal checks may also come up with discrepancies. In case of inconsistency, further action is required and a signal must be passed to the evidence production sub-system. Assuming that all the required information is available, this is a simplistic task.

- **User information:**

Keeping the driver informed about the outcome of the verification process, while at the charging spot, or at the charging area, or even back home, is a crucial part of EETS. Keeping users substantially aware may alleviate considerably the work-load of the violation process. This can be achieved by conventional displays

[1] Of the nine EFC attributes defined in the CEN TC278 standard, only four are physical attributes of the vehicle that could possibly be measured at the roadside. These are licence plate number, dimensions, number of axles (with possibility to differentiate between lifted and on-the-ground axles), and laden weight. Moreover, new charging policies based on environmental parameters (such as emissions and road friendly suspension) are being encouraged by the EC. There is no currently feasible method of measuring such vehicle characteristics on the spot.

on the road for the purposes of static enforcement (mainly for monolane traffic), as well as though EOBU HMI (visual/audio signals of LED/LCD displays and beepers). SMS messages can serve this purpose while at the effective charging area, whereas periodic invoices and the internet can be employed for user information back home.

An externally visible enforcement interface is currently allowed by legislation in only one country (Switzerland).

In some systems - such as the German truck tolling system (TollCollect) - the onboard unit provides visual feedback to the driver of its possible malfunction. The implication is that under enforcement in such systems a driver cannot claim of being unaware of the on-board unit's malfunction.

- **Evidence production:**

Proof of passage is used in different functions such as charging, verification and enforcement. For example, in order to prove that a vehicle has violated the charging process, proof that the vehicle used the road at a particular time is required. An image of the vehicle along with various metadata such as the License Plate Recognition outcome, the location, the date, etc must be acquired to be used in the violation process. The evidence may reside in RSE, the backoffice or the EOBU as standardized log files.

- **Violation process:**

Any vehicle using the road that has not paid the appropriate fee/toll must be dealt with. The mechanics of this process are not a technical issue.

Different technologies can be used for the above purposes. These are described in the following paragraphs in tabular form.

Moreover, the electronic permanent vehicle identification is currently in feasibility study stage. When legislated, it will replace current image acquisition technology for license plate recognition with more cost-efficient and reliable short or medium range communication technology.

6.4.3 ENFORCEMENT TECHNOLOGY ANALYSIS

6.4.3.1 DEDICATED WIRELESS ENFORCEMENT COMMUNICATION

TECHNOLOGY	Dedicated Short Range Communication (DSRC) Communication Technologies

DESCRIPTION AND OBJECTIVES

The objective of the technology is to verify that a vehicle is equipped with a functioning on-board unit. Additionally, in some systems this interface can be used to verify the integrity of accounted transactions.

Following standards of these technologies are in use in the EU:

- CEN MicroWave standard (backscatter microwave communication)
- ISO InfraRed standard (active infrared communication)
- TelePass MicroWave, Italian national standard (backscatter microwave communication)

FUNCTIONALITIES

This interface is used to establish an enforcement transaction with the on-board unit. The enforcement transaction proceeds in free-flow environment. The enforcement system combines this received input data with information from other components such as license plate recognition and vehicle classification. Therefore the on-board unit must provide a unique and non-interchangeable identification, which can be matched with the information retained from other enforcement components. Alternatively, the focus area of enforcement readout can be adjusted to be same as image acquisition area.
The requirements on transferred enforcement data amount and communication range vary among different countries. Some schemes require substantially more data transfer than others, and mobile enforcement requires longer communication ranges than stationary enforcement.
Pole or gantry mounted installations, mobile enforcement, or handheld operation can be supported.

LIMITATIONS

CEN and TelePass MicroWave DSRC:

- Does not support tinted, heat-shielded, and electrically heated windshields without clear ‘window spot’ or external OBU mounting. (Presence of ‘window spot’ cannot be taken for granted, and external OBU mounting is restricted in some countries.)
- Data rate limitation by CEN standard: 500 kbits/sec dowlink, 250 kbits/sec uplink
- Data rate limitation by TelePass standard: described in UNI-10607

ISO InfraRed CALM:

- Sensitive to visibility-blocking obstacle between the OBU and the reading device
- Directionality limitation of beaming width of up to 60 degrees from beam center with current LED implementations. (the OBU can support up to 6 beams aimed at different directions)
- Currently implemented best data rate: 20 Mbits/sec in both uplink and downlink. Standard requires at least 1 Mbits/sec in both uplink and downlink, and defines data rate selection up to 500 Mbits/sec.

SUPPLIERS

- CEN MicroWave version: Q-free, Kapsch, Efkon, CSSi, BRISA, Thales, Telvent
- ISO InfraRed version: AITS, Efkon, IRAT, Q-free[1]
- TelePass MicroWave version: AutoStrade

MAIN TECHNICAL SPECIFICATIONS AND STANDARDS / COMPLIANCE WITH CEN / ISO STANDARDS

CEN, ISO, and Italian UNI standardization describes physical and link layer properties.
ETSI power regulation describes allowed transmission power levels.

CERTIFICATION AGENCIES

TUV.

RELIABILITY

Reliability is described as percentage of successful transactions. The intention is to indicate the expected reliability range of these technologies.
Some supplier estimates might be overly optimistic by comparison to the certifications.
Note that reliability of listed technologies cannot be rigorously compared one-to-one, as transaction data lengths differ among various schemes (for example Austrian truck tolling has enforcement transaction data length of less than 100 bytes, while German truck tolling has data length of 350 bytes – therefore comparison base is shifted)

Certifications known to the expert group:

- CEN MicroWave: 99.5% [2] ('Rechnungshof' - Austrian Audit Office's audit of ASFINAG)
- ISO InfraRed: 99.98% (TÜV certified testing for Taiwanese government)
- TelePass MicroWave: 99.9% [3] (Performance audit by Autostrade per l'Italia, measuring percentage of successful transactions in a closed toll system)

Supplier estimates known to the expert group:

- CEN MicroWave: 99.9% (Q-free estimate), 99.99% (Thales estimate), 99.999% (Fela estimate)
- ISO InfraRed: 99.99% (Efkon estimate)

- TelePass MicroWave: 99.99% (Autostrade per l'Italia estimate)

COSTS

Deployment costs:

150K Euros to 250K Euros per deployment location for fixed installation over 4 lanes plus 2 emergency lanes, of which the cost of short range communication devices (with installation) is about 70K Euros for a typical multi-lane road and the rest is the gantry cost. The main cost factor is determined by mounting gantry/pole type. The cost of gantry-less portable installations should be in the range of 70K Euros for a typical multi-lane road as well.

Mobile mounted installation costs 25K Euros for mobile processing equipment cost (TollCollect case, communications technology independent) plus mobile communications beacon cost (5K Euros in InfraRed case, unkown to the group for other technologies) and cost of the enforcement vehicle.

Operational costs:

Operational costs per deployment location are mainly associated with reliability of DSRC OR CALM readout. In case of transaction errors, a manual verification process in the back-end must ensure that users are not fined incorrectly [4] :

Low-end reliability case (99.5%):

- in the order of 10K Euros per year in case of truck tolling
- in the order of 80K Euros per year in case of passenger vehicle tolling

High-end reliability case (99.99%):

- in the order of 200 Euros per year in case of truck tolling
- in the order of 1600 Euros per year in case of passenger vehicle tolling

Operational costs per mobile enforcement unit are generated by driving and personnel costs of enforcement vehicle. Approximately 30K Euros per vehicle per year plus salaries of one or two operating personnel.

Replacement costs (in case of technology change or update):

Cost of short range communication devices (with installation) is about 50K Euros for a typical multi-lane road (both directions), 15K Euros for a typical single-lane road (both directions). Approximate costs of technology update in three examples:

- Austria (400 multi-lane installations, 500K On-Board Units): 20 Million Euros infrastructure cost, in case of OBU replacement 10 Million Euros additional cost.
- Germany (300 multi-lane and 300 mobile installations, 1 million On-Board Units): 20 Million Euros infrastructure cost, in case of OBU replacement 40 Million Euros additional cost.
- Italy (2000 single-lane antenna installations, 4 million On-Board Units): 30 Million Euros, in case of OBU replacement 80 Million Euros additional cost.

SCALABILITY

The number of gantry/pole installations must increase with the increase of enforced road network. In case of section-based tolling, DSRC OR CALM enforcement is installed at each highway entrance/exit location.
In case of distance-based tolling with fixed enforcement installations, DSRC OR CALM enforcement is installed at every 5 km (Austrian example).
In case of distance-based tolling with combination of fixed and mobile enforcement installations, fixed/portable enforcement is installed at every 80 km, and one mobile enforcement vehicle is deployed per 40 km distance (German example). The scalability goal in this example is to sample roughly 10% of vehicles.

EXAMPLES OF COUNTRIES USING THIS TECHNOLOGY (LIST CONSIDERING EUROPE ONLY)

- CEN MicroWave DSRC: Austria, France, Greece, Norway, Portugal, Spain
- ISO InfraRed CALM: Germany, Netherlands
- TelePass MicroWave DSRC: Italy only (A-deviation from CEN standard)

CONCLUSION OF THE CHAPTER

1. Performance aspect of existing enforcement communication technologies

The different technologies described in this chapter serve the varying needs of different schemes' enforcement applications. Some schemes need small amount of transferred enforcement data, while some schemes require large amount of transferred enforcement data (for example in case of reading out several confirmed invoices). Also, some schemes require safe vehicle-to-vehicle communication distances at high vehicle speeds for mobile enforcement.
As future aspects, enhanced communication security and potential integration of further applications into EETS On-Board Unit should be considered as well:

- For the tolling service's credibility, enforcement communication must support enhancements to communication security: secure reading out of log-files and receipts, mechanisms against manipulation, key management, and appropriate communication time window for smart-card access
- Integration of further applications into EETS On-Board Unit may require high data-rate enforcement communication or mobile enforcement (for example Digital Tachograph enforcement).

The trend for the above mentioned future aspects is leading to a powerful communication medium. Analyzing specifications of currently used enforcement technologies, a combination of described communication technologies may be suitable for current and future aspects as well.

2. Migration aspect of existing enforcement communication technologies

Since Dedicated Wireless Enforcement Communication systems rely on compatibility between On-Board Unit and Road-Side equipment, ensuring such compatibility is crucial for EETS service. It is not expected

that any country would replace its current enforcement system, because of above described prohibiting high associated costs.

Therefore, the most feasible way to introduce suitable On-Board Units for EETS service is to make On-Board Units with combined enforcement interface available. This type of EETS On-Board Unit may support a combination of DSRC and CALM enforcement interfaces in use today: CEN Microwave, ISO InfraRed, Telepass MicroWave. Depending on the use the User requires, the toll operator is allowed to provide Low-cost On-Board Units for regional use, which support only CEN Microwave based enforcement communication.

NOTES AND OBSERVATIONS

[1] *Q-free's InfraRed equipment has gone through field testing in South Korea, no deployment references exist yet.*

[2] Reliability is a function of applied power margin parameters for the physical link. Some deployed systems with high power margin achieve 99.9%, while some deployed systems with low power margin, achieve less than 99.5% (this 99.5% reliability figure is based on the audit of ASFINAG's ETC system in Austria).

[3] Higher reliability of TelePass over CEN DSRC reliability is due to having a two-beacon management for each lane, which allows the radio transmission to be well monitored, and redundant.

[4] Following numbers are used as basis for cost calculation. About 70 seconds of manual verification is required per enforcement record. The calculation is based on assuming 15 seconds average following rate of trucks per road direction and 0.5 cars per second average rate of passenger cars per road direction, assuming multi-lane highway in both directions.

6.4.3.2 VEHICLE CLASSIFICATION TECHNOLOGIES

TECHNOLOGY	Video Classification (or Image Processing Classification)

DESCRIPTION AND OBJECTIVES

The objective of the technology is to verify vehicle dimensions (height, width, length) or more rarely axle numbers, in case this information has relevance to the tolling scheme.

FUNCTIONALITIES

This module is used to classify vehicle dimensions or axle numbers. Classification proceeds in free-flow mono and multi lane environment. The enforcement system combines this received input data with information from other components such as license plate recognition and short range enforcement communication. Therefore focus area of classification must coincide with focus area of license plate recognition.
Pole or gantry mounted installations are supported for height, length and width vehicle measurements (both for mono and multi lane), whereas cameras looking at vehicles from the side are used for axle measurement (only monolane).

ADVANTAGE OVER ALTERNATIVE

- Less integration costs, if same cameras are utilized for license plate recognition as well
- Non intrusive method compared to inductive loops and pressure sensors
- Less maintenance costs compared to inductive loops, pressure sensors or laser scanning systems

LIMITATIONS

Less accurate than alternatives mainly because of spatial occlusion (especially in pole mounting) and varying illumination conditions (e.g. fog, heavy precipitation, shadows) – unless InfraRed technologies with active lighting /LED flashes are utilized.

SUPPLIERS

- Vitronic.
- Kapsch

MAIN TECHNICAL SPECIFICATIONS AND STANDARDS / COMPLIANCE WITH CEN / ISO STANDARDS

- Power supply

- Operational Temperature
- Power Consumption
- Dust protection, water resistance (IP65, IP67, etc)

CERTIFICATION AGENCIES

PTB and TÜV.

RELIABILITY

Assuming vehicles traveling in a free-flow environment (e.g. 100Kmh) and no presence of strobing InfraRed flash illumination, a camera capturing rate of 50 frames/second and an integration time for the CCD camera as small as 1/1000 of a second, the vehicle would still move 3cm in the time it takes for the image to be generated within the camera. This would result in blurring around the edges of the image of the vehicle. Added to the inaccuracies inherent in the edge detection algorithms used in the software, which can only determine the position of an edge to within several pixels, a realistic error on the length and width measurements would be +/- 15cm. Similar figures can be expected for accuracy of the height measurement which depends on the geometry of cameras, their resolution and the algorithms of the processing software.

Accuracy of edge detection is significantly improved with utilization of cameras operating in the InfraRed range and presence of strobing InfraRed flash illumination.

Accuracy of Image Processing Classification (vehicles are attributed the correct class, assuming 5 basic vehicle classes) can be expected to be around 90% (fair).

COSTS

Installation Costs:

The installation cost will depend on the lane geometry (mono or multilane, overhead mounting or sideways). Multiple cameras sharing a common controller or cameras serving also the purposes of image capturing and LPR substantially affect cost as well. Roughly, the cost will be around 4.000-5.000€ per lane (purchase and installation, hardware and software included).

Maintenance & Operational Costs:

The maintenance costs are estimated to be around 6-10% of the installation cost, annually.

SCALABILITY

The number of gantry/pole installations must increase with increase of enforced road network.

Scales well with traffic volume increase.

Scales well with extension from trucks to passenger vehicles.

EXAMPLES OF COUNTRIES USING THIS TECHNOLOGY

Austria, France, US, Norway

TECHNOLOGY	Laser Scanner Classification

DESCRIPTION AND OBJECTIVES

The objective of the technology is to verify vehicle dimensions (height, width, length) or more rarely axle numbers, in case this information has relevance to the tolling scheme.

FUNCTIONALITIES

This module is used to classify vehicle dimensions or axle numbers. Classification proceeds in free-flow mono and multi lane environment. The enforcement system combines this received input data with information from other components such as license plate recognition and short range enforcement communication. Therefore focus area of classification must coincide with focus area of license plate recognition.
Pole or gantry mounted installations are supported for height, length and width vehicle measurements (both for mono and multi lane), whereas laser scanners looking at vehicles from the side are used for axle measurement (only monolane).

ADVANTAGE OVER ALTERNATIVE

- Non intrusive method compared to inductive loops and pressure sensors
- Less maintenance costs compared to inductive loops and pressure sensors
- In some schemes, installed number of axles rather than number of axles touching the ground is relevant, which is not possible to handle with laser scanners

LIMITATIONS

Scanners typically use laser light in the near infrared waveband. Depending on the exact wavelength used, performance could be reduced by rain, snow, or the build up of certain pollutant gasses. Choice of an appropriate wavelength minimizes these problems.

SUPPLIERS

- Efkon,
- OSI LaserScan
- Vitronic

MAIN TECHNICAL SPECIFICATIONS AND STANDARDS / COMPLIANCE WITH CEN / ISO STANDARDS

- Power supply

- Operational Temperature
- Power Consumption
- Dust protection, water resistance (IP65, IP67, etc)
- Laser eye safety regulations

CERTIFICATION AGENCIES

N/A.

RELIABILITY

The accuracy of the profiles derived by the laser scanners has been around +/- 10cm, although commercial figures of +/- 7cm have also been claimed. These accuracies apply to the height and width measurement of the vehicle. Similar accuracies can be expected from the measurement of length if the traffic is flowing smoothly at fairly high speed. In congested conditions, however, the accuracy of the length measurement will decrease and if the traffic is heavily congested the measure could be unreliable.
Accuracy of Laser Scanning Classification (vehicles are attributed the correct class, assuming 5 basic vehicle classes) can be expected to be between 95% and 99.5% (excellent).

COSTS

Installation Costs:
The accuracy of laser scanner classification system depends on the number, and positioning of the range finders. Too many would make the system expensive, but too few may allow vehicles to be lost by occlusion behind others. Thus, installation cost depends on the lane geometry (mono or multilane, overhead mounting or sideways). Multiple scanners sharing a common controller affect cost as well. Roughly, the cost will be around 5.000-7.000€ per lane (purchase and installation, hardware and software included).

Maintenance & Operational Costs:
The maintenance costs are estimated to be around 6-10% of the installation cost, annually.

SCALABILITY

The number of gantry/pole installations must increase with increase of enforced road network.
Scales well with traffic volume increase.
Scales well with extension from trucks to passenger vehicles.

EXAMPLES OF COUNTRIES USING THIS TECHNOLOGY

Austria, Germany, Italy, India, Taiwan, Canada, USA.

TECHNOLOGY	Inductive Loop Based Classification

DESCRIPTION AND OBJECTIVES

The objective of the technology is to verify vehicle type or axle numbers, in case this information has relevance to the tolling scheme.

FUNCTIONALITIES

This module is used to classify vehicle type or axle numbers. Apart from classification this technology is widely used for vehicle detection and camera triggering. By extracting “inductive signatures” inductive loops sufficiently differentiate between vehicle classes. Template matching is a pattern recognition technique that uses templates to represent an average class signature.

Classification proceeds in free-flow environment. The enforcement system combines this received input data with information from other components such as license plate recognition and short range enforcement communication. Therefore focus area of classification must coincide with focus area of license plate recognition.

Inductive loop devices must be embedded in or across the pavement.

ADVANTAGE OVER ALTERNATIVE

- Optimal choice with schemes based on number of axles
- More cost effective than alternatives
- Mature well-understood technology

LIMITATIONS

- Installation damages road (decreases pavement life);
- Inductive loop installation and maintenance is the most disruptive to traffic flow when compared to all other detector technologies
- Most common cause of poor performance is wrong installation
- Subject to stresses of traffic and temperature
- Not recommended for multilane environments

SUPPLIERS

- Idris;
- Peek Traffic.

MAIN TECHNICAL SPECIFICATIONS AND STANDARDS / COMPLIANCE WITH CEN / ISO STANDARDS

- Power supply
- Operational Temperature
- Power Consumption
- Dust protection, water resistance (IP65, IP67, etc)

CERTIFICATION AGENCIES

Switzerland, Germany and the Netherlands have employed national IL specifications that must be met as well as equipment acceptance testing.

RELIABILITY

Accuracy of Inductive Loop Classification (vehicles are attributed the correct class, assuming 5 basic vehicle classes) can be expected to be around 90-95% (fair) in a free-flow mono-lane environment.

COSTS

Inductive loop based classification is relatively inexpensive compared to alternatives. Rough component costs are given below.

Installation Costs:
Loop with amplifier (purchase and installation) between 500 - 1000€ per loop
Controller between 1500-2500€ per unit (can host multiple loops)

Maintenance & Operational Costs:
The maintenance costs are estimated to be around 10-15% of the installation cost, annually.

SCALABILITY

The number installations must increase with increase of enforced road network.
Scales well with traffic volume increase.
Scales well with extension from trucks to passenger vehicles.

EXAMPLES OF COUNTRIES USING THIS TECHNOLOGY

All over the world for a variety of transport applications (tolling, parking, vehicle counting, traffic safety, incident detection, etc).

TECHNOLOGY	Pressure Sensors Based Classification

DESCRIPTION AND OBJECTIVES

The objective of the technology is to verify axle numbers and axle spacing and as a result of these the vehicle type, in case this information has relevance to the tolling scheme.

FUNCTIONALITIES

This module is used to classify vehicle type based on axle measuring and axle spacing. Apart from classification, this technology is also used for vehicle detection and camera triggering. Due to poor performance under congested traffic or temperature changes, pressure sensors can be used in combination with other classification technologies, especially the non-intrusive ones that lack axle numbering capabilities (e.g. overhead image processing cameras, or scanners).

There are different types of pressure sensors, namely pneumatic tube, metal contact, piezoelectric, etc. Even infrared beams and fiber optic strips can be embedded in tubes to achieve the same effect. From the above the pneumatic tube is the most widely used around the globe for a variety of traffic applications, whereas the piezoelectric is relatively new technology.

The enforcement system combines this received input data with information from other components such as license plate recognition and short range enforcement communication. Therefore focus area of classification must coincide with focus area of license plate recognition.

Pressure sensors must be embedded in or across the pavement.

ADVANTAGE OVER ALTERNATIVE

- Good choice with schemes based on number of axles
- Cost effective than alternatives
- Mature technology

LIMITATIONS

- Very sensitive to temperature changes
- Not recommended for congested environments (difficulties in differentiating among closely spaced vehicles)
- Not recommended for multilane environments
- Requires extensive maintenance and frequent calibration
- Installation damages road (decreases pavement life) and disrupts traffic
- Not able to measure number of axles installed on vehicle, just number of axles touching the ground (some schemes might require to detect total number of axles on vehicle)

SUPPLIERS

- Diamond Traffic;
- Peek Traffic;
- Sensor Line;
- Measurement Specialties Inc.

MAIN TECHNICAL SPECIFICATIONS AND STANDARDS / COMPLIANCE WITH CEN / ISO STANDARDS

- Power supply
- Operational Temperature
- Power Consumption
- Dust protection, water resistance (IP65, IP67, etc)

CERTIFICATION AGENCIES

PTB.

RELIABILITY

Accuracy of pressure sensors in terms of classifying vehicles (vehicles are attributed the correct class, assuming 5 basic vehicle classes) can be expected to be less than 80% (poor) in a free-flow mono-lane environment.

COSTS

Pressure sensors based classification is relatively inexpensive compared to alternatives. Rough component costs are given below for piezoelectric sensors.

Installation Costs:
Purchase and installation between 500 - 1200€ per lane sensor

Maintenance & Operational Costs:
The maintenance costs are estimated to be around 10-20% of the installation cost, annually.

SCALABILITY

The number installations must increase with increase of enforced road network.
Scales well with traffic volume increase.
Scales well with extension from trucks to passenger vehicles.

EXAMPLES OF COUNTRIES USING THIS TECHNOLOGY

All over the world for a variety of transport applications (tolling, parking, vehicle counting, traffic safety, incident detection, etc).

NOTES AND OBSERVATIONS REGARDING VEHICLE CLASSIFICATION

In order to make all classification technologies comparable accuracy is calculated roughly in terms of attributing the correct vehicle class, assuming 5 basic vehicle classes (motorcycles, small passenger cars with 2 axles, vehicles with 3 axles, 4 axles and above). Numbers refer to monolane, free-flow (up to 100Km/h). Keep in mind though, that image processing and laser scanner classification systems sustain these performance figures even in multilane free-flow situations (of course in classification schemes other than pure axle measurement), whereas loops and pressure sensors cannot be considered in these setups.

6.4.3.3 LICENSE PLATE RECOGNITION

TECHNOLOGY	Automatic License Plate Recognition (ALPR)

DESCRIPTION AND OBJECTIVES

This technology is intended to be used in EFC systems for the purpose of license plate number recognition and it is able to identify and recognize the characters of the license plate, to deal with different formats of licence plates and to determinate the country of origin, with a high level of confidence, mitigating the need for a visual treatment of pictures taken of vehicles.

The system can operate in a standalone basis or integrated within the local toll software system. In the first case, the ALPR system is installed in the image cameras and manipulates directly the uncompressed pictures captured from the image equipment. In the second case, the ALPR system works physically independently of the image equipment - the pictures are taken by the installed cameras and then send to the local toll system, in a compressed format, then being processed (with some loss of quality) by the ALPR engine.

FUNCTIONALITIES

The main functionalities of this ALPR system are:

- Image capturing: This is the main functionality of this ALPR system, once the images captured are the beginning of the process of licence plate number recognition and their quality is the basis for the success of that recognition. This functionality is supported by high-resolution colour cameras and infrared cameras that are activated through a controller which has installed road-traffic sensors a trigger, and an infrared flash or constant illumination equipment.

- Licence plate number recognition: This is the central functionality of the ALPR system and is composed by a set of sub-functionalities, which are:
  - Interpretation of the content of a defined visual data that extracts only the important information (based on some license plate forms and characteristics). This functionality is available due to the existence of an engine that, based on an image processing software library and a set of procedures to search and interpret that library, has the ability to read different formats and characteristics of license plates of different countries.
  - Identification and recognition of the characters included in the licence plates.
  - Adaptation to different light conditions (through automatic mechanisms installed).

- File manipulation: The ALPR system has also the capability to create files and transfer them to a central system to posterior treatment. This functionality is supported by the following procedures:
  - Creation of a PIP (Picture in Picture) file by each picture taken, where it is present a colour image of the rear-side of the vehicle, both of the images taken by the infrared cameras of the front and rear license plate and the number plate recognised by the ALPR/OCR engine.
  - Image compression (with or without data losses).
  - Exportation of the files to a central system. This operation could be configured to be done every time a PIP file is

created or periodically.

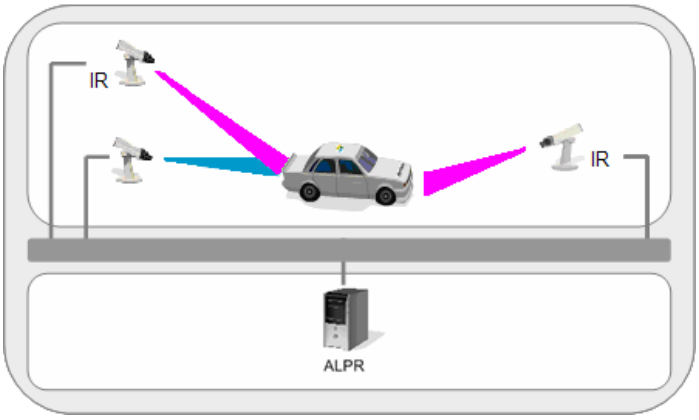
- Monitoring: The ALPR system has a component for the control of the operations done by the system.

SUPPLIERS

- BRISA (Portugal)
- EFKON
- Peek
- ARHungary
- PIPS Technology
- Vitronic

MAIN TECHNICAL SPECIFICATIONS AND STANDARDS / COMPLIANCE WITH CEN / ISO STANDARDS

The technical schema for the ALPR system (in what concerns with equipment) is the one represented on the picture below.



In the picture it's possible to verify that there are three main equipment components: 1 high resolution color camera, 2 infrared cameras and a ALPR engine. The technical specifications for each of these components are:

ALPR Engine:

- Supported Operating System: WinNT, Win2K, Linux
- Programming Languages: Visual C/C++ 6.0; Visual Basic 6.0; Borland Delphi 5.0; C/C++ under Linux
- Additional Tools: SDK for easy integration; ActiveX, Delphi components; JPEG Codec
- Image Input; Memory, file
- File Types; BMP, JPEG
- File Formats: Grayscale, RGB16, RGB24, RGB32, YUV
- Image Size: Minimum 300 x 200 pixels; Maximum 2500 x 2000 pixels
- Processing Time Dependence: Image content (complexity); Image size; Processing power (CPU speed); Parameter settings

- Sample Processing Time: 100ms @ CPU 500MHz, 768 x 288 pixels (PAL/2)
- Output: Plate number in ASCII; Plate position; Positions of characters; Tip list for each characters; Confidence levels for each tips

Main camera and illumination types:

- ALPR High Resolution Color Camera
- ALPR Monochrome Camera

Lately, EFC enforcement is done mainly by progressive scan cameras for image quality reasons.

Best image quality and contrast is generally achieved with InfraRed flash illumination, which emits multi-frequency light in the 850-950 nanometer range. The possibility to tailor the InfraRed band to a window in the absorption of e.g. water, snow and ice even allows high quality pictures if there is rain or snowfall or some coverage of license plates by snow. The InfraRed flash is also recommended because it does not disturb drivers. In case of its utilization the camera lens must be designed for proper diffraction in the InfraRed range, and the filter must be compatible. In typical applications flash time of 500 microseconds or less is appropriate – it gives sharp image up to vehicle speeds of 180 km/h. In case of higher vehicle speeds a shorter flash time is needed – an LED based InfraRed flash is recommended for very short flashing times.

The InfraRed flash is not producing good results in case of red characters over white plate. In case such combination is a possibility (allowed for example in Belgium), blue light illumination is recommended.

CERTIFICATION AGENCIES

N/A

RELIABILITY

This technology has proven to be effective and reliable, with high levels of confidence to identify the characters of the license plate. The ALPR has a level of confidence greater than 80% (without infrared flashes and cameras), which was tested on different levels of illumination. In case of using infrared flashes and cameras the level of confidence reaches approximately 90 %.

The reliability of ALPR is also dependant on whether there are some known facts about the possible plate numbering scheme – for example letters at first two character locations or a number at last character location.

COSTS

In what concerns with costs, it will have to be considered the following types:

Installation Costs

The installation cost will depend on the modality selected: standalone OCR engine per lane or single OCR engine for multiple lanes. In the first case, the cost will be € 5.500 / lane, including € 1.500 for the OCR engine licensing. In the second case, the cost will be € 1.500 for the licensing and then € 4.000 /lane. Additionally, equipping of Infrared flashes costs approximately € 1.500 /lane. These costs do not include trigger cost - it is implied that classification equipment is

utilized as triggering device.

Maintenance Costs

Yearly maintenance cost mainly depends on whether cameras can be cleaned without closing of the lanes. Current cameras need to be cleaned about twice per year. In case a walkable gantry is installed and legislation allows using it, yearly maintenance cost can be about 10% of deployment cost. Otherwise yearly maintenance can reach 100% of deployment costs because of high lane closure costs.

Operation Costs

Operating cost is about 0.1 euro per license plate processed in standalone ALPR system.

SCALABILITY

An ALPR system has a great potential to support the increase on operations, being able to process a large number of license plates even with an increase of the toll system and/or need of enforcement. In order to carry out the increase of operations, maybe will be necessary, depending on the actual performance of the system, to upgrade some components that influence the processing performance of the system.

EXAMPLES OF COUNTRIES USING THIS TECHNOLOGY

The technology for license plate recognition is used by Contract Issuers from different countries (Hungary, Portugal, among others).

DATA REFERENCE OF PRESENTED TECHNOLOGY ANALYSIS

Performance and cost figures regarding enforcement technologies are presented to the best knowledge of the Expert Group, along with feedback received from manufacturers. Following major suppliers have been asked to provide performance and cost figures of their equipment: Autostrade per'l Italia, CSRoute Efkon, Fela, Kapsch, Norbit, Q-free, Thales, Vitronic. The group has made use of available performance audits and certified power budget calculations performed by the following organizations: Austrian Rechnungshof, Autostrade per'l Italia, TUV.

6.5 Management Agency

The EETS is an EFC cross border service making it mandatory that different players form different countries adopt a minimum set of common technical, commercial, operational and legal guidelines. Running, maintaining and developing such service requires, in the view of Expert Group 10 members, a central and neutral agency with regulatory and certification authority. Although not being a target of this Expert Group we found it appropriate to list some recommendations which we feel are necessary for the success of the EETS service:

1 – It should be an European public entity governed by the EC, more specifically by DGTREN (a private entity participated by a set of EFC Players from different countries will delay the launch of the service; it may a solution for a second phase), but in any case a European Body with executive powers;

2 – The structure and scope of this entity is a fundamental part of the EETS service. For this reason we propose that it included in the definition of the EETS service, expected for next summer;

3 – It shall operate as an information hub for all EETS Countries (at least for administrative issues, especially those related to cross border enforcement;

4 – It shall define EETS equipment, systems and procedures certification policy (scope, requirements applicable to certifications centres, rules and procedures for accreditation of certification centres, certification centres audits and accreditation, resolution of certification disputes;

5 – It may undertake Security Management tasks, such as establishing and distributing security keys among TSP/EFCO/Enforcement Agencies and CIs, assuring the global security of EETS enforcement procedures.

6 – It shall define minimum requirements for the acceptance of a TSP, EFC Operator and Contract/Equipment Issuer and maintain the list of accepted players;

7 – It shall be the escalation instance to solve technical, procedural, commercial or operational disputes that may occur between players;

8 – It shall define and ensure the technical and procedural interfaces between TSPs7EFCOs/Enforcement Agencies and the Contract Issuers for information about Contracts issued, based on License Plate Number (this information is needed to enforce users with EETS contract; however, this should be extended to all contracts issued in the EU and other participating countries also for national schemes)

9 – Manage promotion initiatives regarding the EETS;

10 – It may also be an escalation instance for the User in the resolution of claims and disputes regarding the EETS service;

11 – It shall be the official interface with entities with relevance for the EETS, namely:

- non-European countries in trying to enlarge the number of countries adopting the EETS service (important in terms of enforcement);
- standardization entities;
- associations (ASECAP, IRU, ACEA, etc);
- equipment manufacturers;
- national road authorities.

6.6 Expert Group Members and Contacts

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