COMMISSION OF THE EUROPEAN COMMUNITIES

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COMMUNICATION FROM THE COMMISSION

TO THE COUNCIL, THE EUROPEAN PARLIAMENT,
THE ECONOMIC AND SOCIAL COMMITTEE
AND THE COMMITTEE OF THE REGIONS

on

INTEROPERABLE ELECTRONIC FEE COLLECTION SYSTEMS IN EUROPE

SUMMARY

1. Electronic Fee Collection (EFC) systems offer the possibility of charging road vehicles in a highly flexible way. This enables the implementation of charging policies for the use of infrastructure to improve transport efficiency, allowing the recovery of costs and/or the management of traffic. It is important that such systems be interoperable across national borders to avoid creating new obstacles to traffic flows in Europe, in accordance with the Single Market provisions of the Treaty.

2. Ultimately, interoperability should enable users to pay tolls without changing their on-board equipment or reverting to manual payment when they cross the boundaries of different EFC areas. At the present time, however, EFC is at very different stages of implementation in various European countries and the Council[1] has requested a strategy for convergence of EFC systems to an appropriate level of interoperability in the European Union (EU).

3. In the intermediate convergence period, the degree of interoperability between EFC systems may be different between countries. Equally, the methods by which this intermediate degree of interoperability is achieved, and the corresponding costs may be different. However, the long term objective is that all European EFC systems will enable the use of interoperable on-board equipment by traffic moving from one system to another.

4. In addition, the use of EFC for road pricing or access control to manage traffic is being considered by many as a possible contribution to a solution for the growing traffic congestion in urban agglomerations in Europe. Interoperability between urban and interurban applications therefore needs to be taken into account in the development and implementation of EFC systems. This will mean close co-operation between those responsible for achieving cross-border interoperability, and those dealing with urban schemes.

5. This Communication examines the **issues** involved in developing a framework for the timely deployment of interoperable EFC systems in Europe able to support the implementation of current and future agreed charging policies while allowing national and regional variations. It proposes the best approach in resolving these issues, allowing in particular the implementation of the Commission proposals in the White Paper "Fair Payment for Infrastructure Use"[2] on distance related charging with differentiation of rates according to vehicle and geographical characteristics.

   a) First major issue : **Technical interoperability**. Existing EFC systems for motorway tolling make use of Dedicated Short Range Communication (DSRC)

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[1] Council Resolution 97/C 194/03 of 17.6.1997 on the development of telematics in road transport in particular with respect to electronic fee collection, OJ C 194 of 25.6.1997

[2] Commission White Paper COM(98) 466 final of 22.07.1998 on Fair Payment for Infrastructure Use: A phased approach to a common transport infrastructure charging framework in the EU.

between the roadside and the vehicle. The feasibility of the DSRC technology has already been demonstrated, and European pre-standards have been agreed, which are not always compatible with the existing systems.

An alternative system being considered makes use of satellite location (GNSS[3]) and mobile telephone technology (GSM). The individual basic technologies for satellite location and mobile telephone communication are well proven, but tolling applications based on the combination of these technologies are not advanced. The technology chosen will depend ultimately on the specific requirements, the timetable involved and the state of technological development.

The first task should be the definition of a common minimum level of functionality for systems to enable drivers to use their onboard payment device on the networks of all the operators in the system. The scope for the development of equipment able to use both technologies needs to be examined.

b) Second major issue : **Contractual interoperability**. The availability of technically interoperable equipment needs to be accompanied by contractual agreements between operators, and also between operators and other possible issuers of payment means. All relevant issues are being examined within EU-sponsored projects with a view to the conclusion of a Memorandum of Understanding by the relevant actors.

c) **Non-equipped users** : An issue of particular importance is the treatment of users who are not equipped with the necessary electronic on-board payment device. Within realistic expectations for non-discrimination, EFC systems need to be designed so that such users are not subjected to cumbersome and time consuming alternative payment procedures or to penalising prices. Within these constraints Member States introducing EFC systems may apply the options best suited to their circumstances for the treatment of non-equipped users.

d) **Classification** : Vehicle classes used in each country do not themselves require harmonisation in order to achieve interoperability, although such class harmonisation would facilitate comparability and simplify users' understanding of charges. An acceptable set of vehicle attributes, which can be used for classification purposes, is essential and needs to be agreed. Work on this has already started within EU-sponsored projects under the 4th Framework Programme and the Trans-European Transport budget. Work is also well advanced in the European Standardisation bodies for drawing up a standard on classification parameters. To enable EFC systems to fulfil the likely requirements of future charging and pricing legislation, this set could include in addition to the usual vehicle characteristics, environmental attributes, such as emission and noise characteristics. As some of these attributes cannot be measured dynamically, they need to be stored in the vehicle on-board

[3] GNSS : Global Navigation Satellite System.

equipment and interoperable EFC systems must be able to handle them. Member States may elect to charge vehicles using any combination of these declared attributes and / or the usual measured characteristics.

e) **Enforcement** : Failure to enforce payment negates the policy objectives, and results in loss of credibility for the operators as well as loss of revenue. Enforcement must therefore form an integral part of any fee collection system. At present, the technical integration of system components to enable fully automatic enforcement in multi-lane systems presents a challenge in meeting operational reliability requirements. Effective cross-border information exchange and prosecution of offenders needs agreement on forms of evidence and on procedures. The potential for successful enforcement through the establishment of close links and co-operation between tolling enforcement agencies and national registration data bases should be explored.

f) **Fraud** : The incidence of fraud may increase as interoperable systems extend over wider geographical areas. Until an acceptable degree of system security is achieved, operators may wish not to enter into the contractual agreements which are necessary for systems interoperability. On the other hand, users need to be assured of an acceptable degree of data protection and privacy, which may vary according to different national approaches and traditions as well as according to requirements of individual users or user groups.

6. The aim is to define a **strategy** and actions which give satisfactory answers to the issues above : the objective is that EFC systems in Europe should converge to "an appropriate level of interoperability". In determining what is to be considered as appropriate, it is necessary to take into account many factors. These include EU and national policy requirements, requirements of operators for system resistance to fraud, the desire of some users for anonymity, the extent of deployment of existing systems, the cost of changes to these systems, and the agreed timetables.

7. This strategy will be developed respecting EU and national legislation and principles, like non-discrimination between users and data and privacy protection. In the medium term it seems most probable that each country according to its own national requirements will deploy its own EFC system but with sufficient common functionality to enable drivers to use their on-board equipment at least in several countries.

8. Priorities for implementation need to tie in with policy priorities for introducing/developing charging systems. This means that immediate action should be undertaken to implement such systems for certain classes of vehicles, like Heavy Goods Vehicles (HGVs), to which EU charging rules already apply[4], and also to long distance coaches. This is the category for which the single market arguments for both a common approach to charging, and international interoperability are strongest. A further advantage of starting with HGVs is that enforcement, privacy protection and

[4] Council Directive 93/89/EC of 25 October 1993 on taxes and charges on HGVs, OJ L279/32 of 12 November 1993

the question of non-equipped users could be easily solved. However, in giving priority to charging systems for HGVs and long distance coaches, no obstacle should be placed in the way of wider interoperability of systems.

9. An EU strategy to achieve interoperability of EFC systems, allowing for convergence of existing and future systems will therefore require a phased approach. This is also in line with the phased approach for infrastructure charging put forward by the Commission in its White Paper.

10. **Main actions in the first phase** (1998 to 2000) will be based on the following key assumptions:

i. priority will be given to interoperability of EFC systems for HGVs and long-distance coaches used on the Trans-European Road Network (TERN). This will need to provide the means to implement decisions on EU wide charging policies. The Commission's White Paper proposed application to commercial operators of greater cost-related charging, differentiating by time, vehicle characteristics, route and so on, by 2004.

ii. interoperability between urban and inter-urban applications also needs to be given priority in the development and implementation of EFC systems

iii. an open-system architecture will be necessary, capable of responding to policies developed at EU or national levels, of integrating further operational and technological developments, and enabling commercial opportunities. Such an architecture would require consideration of dual or multi-mode equipment which would permit the use not only of DSRC technology but also of GNSS-based systems or other technology, where appropriate, in response to policy need or operational convenience. The architecture should also allow the potential exploitation of EFC-based technologies for traffic management and value-added services.

Achieving these objectives will require action by the Commission, the Member States, local and regional authorities, concessionaires, and by the standards bodies.

These actions will be :

a) to define and agree a **common minimum level of functionality** at the EU level (ie the basic features needed in order to achieve interoperability, e.g. capacity to distinguish types of vehicle, methods and arrangements to effect payments etc) , reflecting policy and operational requirements. This will be based on work done within EU-sponsored projects under the 4th Framework R&D Programme particularly on Transport Telematics Applications and of the Trans-European Network – Transport Programme. Any additional actions will be undertaken in the 5th Framework Programme.

b) to enable these common functions to be performed, **CEN** (Comité Européen de Normalisation) should complete its work on EFC on the basis of Mandate 270 from the European Commission, developing, validating and adopting standards on DSRC and other areas, where appropriate. These standards should enable multilane operation and the introduction of traffic management and other value-added services, using the same technology.

c) The Commission will help all interested parties to complete the work on **contractual interoperability** by promoting the signature of a Memorandum of Understanding between them, based on an EU framework agreement.

d) The Commission will explore ways to facilitate cross-border enforcement and to adequately cover privacy and data-protection issues.

e) The Commission will co-operate with cross-national groups of urban or regional authorities considering the introduction of road pricing, so as to offer a co-ordinated approach between local systems and between them and inter-urban services.

11. The Commission will put forward proposals for actions in subsequent phases on the basis of the results obtained in the first phase, and ongoing policy developments. The aim will be to achieve a convergence strategy for interoperability of EFC systems as requested by the Council. Failure to achieve interoperable EFC systems will cause disbenefits for the European citizens, especially long distance drivers who will be confronted with artificial borders between the different Member States, obliging them to use different cards or onboard units, or to stop and pay cash at toll booths. European industry will loose a competitive advantage on the world market, due to the proliferation of proprietary systems, and the resulting absence of economies of scales. Finally, road operators will also suffer because of increased equipment costs and restriction on their freedom of choice.

12. In the meantime, the Commission recommends that decisions by national and local administrations or private concessionaires on EFC systems should be based on this Communication.

The Commission therefore asks the Council and the Parliament to endorse this first stage in a convergence strategy for EFC systems in Europe and the assumptions on which it is based.

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1. INTRODUCTION

13. Many road authorities now seek the recovery of construction, operation and maintenance costs of roads through tolls or other road use charges. In addition, many governments and city authorities are also considering some form of road pricing to manage traffic demand and to reduce the negative impacts of transport in terms of congestion, accidents and pollution, thereby improving the safe and efficient use of existing road infrastructure.

14. These trends associated with substantial increases in road traffic lead to the consideration of charging systems which are able to levy road charges automatically and without the need for drivers to perform any additional actions beyond those related to normal driving activities. The systems should enable the collection of such charges at normal highway speeds and without creating obstacles to traffic flow as a result of lane segregation.

15. In some countries with a long established tradition of motorway tolling, Electronic Fee Collection (EFC) systems have already been introduced, alongside manual payment methods using toll booths. This was a response to the wishes of motorists for a faster and more efficient service and of the operators for a more cost-effective operation. With the expansion of EFC systems, either newly introduced or as replacements of previous manually operated toll systems, the need for interoperability becomes increasingly pressing.

16. Interoperability from the point of view of users is the ability to travel throughout the Union without having to adopt procedures different from those of their own countries and without having to install extra equipment when changing from one charging area to another. Interoperability is an important factor in serving Single Market and sustainable transport policy objectives, and contributing to the creation of the internal market for industry and the development of the Information Society. This justifies action at the EU level to achieve interoperability between EFC systems.

17. In 1993, when the first harmonised Community approach on vehicle taxation and tolling for Heavy Goods Vehicles was established[5], the Council requested Member States intending to introduce electronic toll systems to bear in mind the desirability of interoperability between systems. In order to address the issues raised by this requirement, CARDME[6] was established to promote consensus on medium to long term strategies for convergence to full interoperability of EFC systems on European roads.

18. Later, and in the light of ever increasing traffic congestion, environmental pollution and transport accidents, the Commission presented in 1995 its Green Paper on Fair and

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[5] Council Directive 93/89/EEC of 25.10.1993 on the application by Member States of taxes on certain vehicles used for the carriage of goods by road and tolls and charges for the use of certain infrastructures, OJ L 279 of 12.11.1993

[6] Concerted Action for Research on Demand Management in Europe

Efficient Pricing in Transport[7]. In it the Commission put forward the view that prices paid for individual journeys should be better aligned with the real costs of these journeys. As costs differ across time, space and transport modes, this implies a need for more differentiation and transparency, which can only be met by some form of electronic road pricing. However, the Green paper says that care should be taken to avoid the deployment of incompatible systems and to establish European-wide rules for interoperability. The Commission has now put forward more concrete proposals in a White Paper for transport infrastructure charging. This takes the form of a coherent framework on infrastructure charging in different modes. Its main relevance for EFC is that it sets out a timetable for implementation, and gives clear priority to action on HGVs, leading towards a differentiated kilometre charging system.

19. Last year, the European Commission adopted a Communication[8] to the Council and the European Parliament on a Community Strategy and Framework for the Deployment of Road Transport Telematics in Europe. In its proposals for initial actions the Commission has identified EFC as one of the priority areas in road transport telematics at EU level, where action is needed in order to devise and implement a strategy to achieve convergence between existing and new systems in order to ensure an appropriate level of interoperability Europe-wide.

20. The Council of Ministers adopted a Resolution[9] on the deployment of Road Transport Telematics, with particular emphasis on EFC systems. This again stresses the importance of developing a strategy for convergence of EFC systems in Europe taking into account already existing systems and the work of the European standardisation bodies in order to achieve an appropriate level of interoperability at a European level.

This Communication examines the obstacles to interoperability of EFC systems and sets out a recommended approach to achieve an appropriate level of interoperability at European level. It is not its aim to examine any aspect corresponding to the charging policies of the Member States or the EU for road transport, like for instance variation of charges by road type, or time. The assumption is that interoperable systems should enable all agreed policies to be implemented.

The international dimension of road freight transport in the EU, the Single Market logic which precludes the creation of barriers to intra-Community transport and commerce by road, the plans for new inter-urban EFC systems, as well as the Commission proposals for road pricing, starting with commercial transport, all point to the need to give priority in our work at EU level to EFC systems intended for use on the TERN and applied to HGVs and long-distance coaches and buses.

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[7] COM(95)691 final of 20.12.1995 Towards fair and efficient pricing in transport - Policy options for internalising the external costs of transport in the European Union

[8] COM(97) 223 final of 20.05.1997 on a Community strategy and framework for the deployment of road transport telematics in Europe and proposals for initial actions

[9] Council Resolution 97/C 194/03 of 17.6.1997 on the development of Telematics in road transport in particular with respect to Electronic Fee Collection, OJ C 194 of 25.6.1997

21. In line with the principles of subsidiarity and proportionality, the approach is designed to ensure that necessary progress on EFC has been made to allow implementation of current and future agreed charging policies while allowing national and regional variations.

2. EVOLUTION OF SYSTEMS

22. The original road tolling systems involved vehicle drivers stopping at a barrier and paying the toll keeper who then opened the barrier. This simple procedure was most suitable for low traffic densities. It had the advantage of ensuring that all vehicles paid according to their classification while, at the same time, the privacy of the driver was maintained.

23. Before the advent of suitable telematics technology, payment was invariably manual and large toll plazas were constructed to avoid queues as drivers stopped to pay. Toll systems may be "open", where a toll plaza is just a payment point at a defined location, or "closed", where the exact entry and exit of the motorway are monitored and payment is made at the exit. Both systems have advantages and disadvantages depending on general policy, traffic flows, land available and other possible items, and operators study carefully the type used for each section. With increasing traffic densities and technical progress, electronic road tolling systems, using a microwave communication between the vehicle and the roadside, have been introduced in one or more lanes of the toll plazas. Even if barriers are often retained to ensure payment, this allows the flow of the plazas to be increased and reduces the average queuing time for the drivers. Non-equipped drivers still have to pay manually. The plaza designers have usually dedicated some lanes to these electronic systems, to get full advantage of the technology, when the number of subscribers was large enough. These systems are referred to as "monolane systems". Due to the lack of any standard, they have been developed without any provision for interoperability across concession borders.

24. Some EU Member States do not presently apply tolling on their motorways and do not wish, for a variety of reasons, to build toll plazas. Instead, they are considering introducing "multilane" free flow systems in which drivers passing toll collection points do not need to reduce speed and remain free to change lane. Multilane applications do not require toll plazas, but at most, only specific equipment mounted on gantries at the tolling points to ensure tolling functions : vehicle detection, classification, payment and enforcement. The infrastructure required is minimal. EFC systems to deal with these requirements have been demonstrated, but some questions about overall reliability remain to be tested, taking into account the need for vehicle classification and enforcement of payment.

25. Two alternative technologies for electronic fee collection are being developed : one based on microwave technology (Dedicated Short Range Communications - DSRC) and the other based on satellite positioning (GNSS) and mobile telephone (GSM) technology. The feasibility of the DSRC technology in the 5.8 GHz frequency band has already been demonstrated and European pre-standards were adopted in 1997. Although this basic frequency band has been formally designated by ERC (European Radiocommunication Committee - Decision of 22 October 1992) for the co-ordinated introduction of Road Transport Telematic systems, it may be necessary to review the

corresponding bandwidth requirements in the near future in order to allow for services other than EFC. Further work is currently in hand to ensure that new industrial equipment of different providers are compatible with each other. This should be completed by the year 2000. On the other hand, although the basic technology for satellite location and mobile telephone is well proven, and opens up further options, tolling applications based on a combination of these technologies are not advanced. Satellite location technology will be used to define whether or not the vehicle is on a charged road, and for payment related to kilometres travelled, to compute the travelled distance. The GSM technology will be used to collect payment. In case of application of these technologies to a payment principle based on distance travelled, interfacing the payment equipment to the digital tachograph, if any, should be considered as this may be an option for HGVs. Further R&D work is required to prove the integrated concept.

26. Some EU countries already have developed or are developing an internal policy using short range microwave technology, enabling drivers to use the same onboard equipment over the whole national network. But the drivers must revert to manual payment when driving outside their home countries, as there is no cross-border interoperability of EFC systems in Europe at present.

3. THE CHALLENGE OF INTEROPERABILITY

3.1 General

27. *Interoperability means that drivers, equipped to pay motorway tolls using the EFC system in one country or concession area, are able to pay tolls in any other country or concession area without having to use different on-board equipment. It does not mean that there would be one single supplier, but that there should be sufficient technical compatibility between different systems, backed up by contractual agreements between operators, so that to drivers, paying tolls on different stretches of road in the Union would be a seamless operation.* A second objective is that the on-board equipment (OBE) installed for payment of motorway tolls should, if possible, be suitable for use in urban areas for traffic management and possibly for other payment applications.

28. Member States have agreed that interoperability is desirable[10] and have stated that "an appropriate level of interoperability between EFC systems in the Community must be achieved so as to provide an optimum service to the user in reasonable economic conditions and without creating any unnecessary bureaucracy".[11] They have not defined these concepts in a way which would enable a comparison to be made between the net benefits and the additional costs which might have to be incurred.

Users will benefit from interoperability in terms of convenience, reduction in travel time and operating costs as well as the opportunity for added value services.

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[10] Council Directive 93/89/EEC of 25 October 1993 on taxes and charges on HGVs, OJ L279/32 of 12.11.1993

[11] Council Resolution on Road Transport Telematics and EFC : 97/C 194/03 of 17.06.1997 previously mentioned

29. In general, operators are concerned with maximising revenue and will experience financial benefits from interoperability if it results in lower costs or in more vehicles using motorways than would otherwise be the case. If the achievement of pan-European interoperability requires the involvement of issuers of payment means other than the operators themselves, this may be seen as a disadvantage with a possible adverse effect on the immediate cash flows of the motorway operators. The charges made by finance houses acting as issuers must be sufficiently low to ensure acceptability to users and operators.

30. Manufacturers are likely to benefit from the use of standard interchangeable equipment, especially when convergence between new systems and established systems has been achieved. Their penetration on the market might be significantly increased if the equipment was providing other related services in addition to toll charging, such as parking payment, access control, plus added value services.

31. Work done by CARDME has concluded that *interoperability can only be possible if appropriate agreements are reached at the technical, procedural and contractual levels*. Broadly speaking, these concern respectively : the physical characteristics of the communication between vehicle and roadside equipment, the organisation and processing of the data which are exchanged (including the steps and algorithms of the transaction process), and the relations between users and operators and with potential third parties such as financial institutions.

32. At the most basic *technical level*, vehicle on-board equipment based on DSRC technology must be able to communicate with roadside or ground equipment in each country or concession area. The CEN pre-standard for Dedicated Short Range Communication links (DSRC), which has recently been adopted, enables, rather than guarantees, communication, as system elements based on different permitted choices of technical parameters will not necessarily be able to communicate. Therefore, further agreements on the communication parameters between national authorities and operators in co-operation with industry will be necessary to guarantee technical interoperability. Since this CEN pre-standard is not compatible with some existing operational EFC systems in Europe, a strategy for convergence to pan-European interoperability is needed.

33. The fact that systems using satellite navigation and mobile telephone technologies are being considered by some countries adds to the complexity of interoperability. As mentioned earlier, vehicle location in these systems uses satellite location technology while payment is by means of cellular communication between vehicle and a central system. Interoperability is needed not only between different systems of this kind, but also between these systems and DSRC systems. However contractual and procedural rather than technical solutions may provide this interoperability.

34. Such technologies, i.e. DSRC and GNSS/GSM might be used for other applications than Electronic Fee Collection, like Route Guidance, Traffic Management, Protection against Car Theft, Logistic Fleet Management... Systems and services are already under development and testing in some Member States as well as abroad. These services will increase the potential number of subscribing vehicles and the needs for technical interoperability. They may affect the technical design of the equipment, but not the work already done in the standardisation bodies, who considered applications

wider than EFC. Equipment for these services should be backward compatible with EFC systems as they are developed.

35. At the *procedural level*, the functionality of the on-board equipment must match that required by the tolling application. This means that the information passed between the on-board equipment and the roadside during the transaction must provide the necessary information to enable guaranteed payment to the operator.

36. The draft pre-standard for the definition of the application interface between the on-board equipment and the roadside appears to offer the required framework for procedural interoperability for DSRC systems and a similar interface definition for systems using satellite location is being developed. However, some on-board equipment may conform to the standard but still not have the required functionality for a particular application since choices can be made within the standards. Therefore, an agreement is required on a minimum common functionality for on-board equipment that is required to be interoperable. Agreement on a common minimum level of functionality would enable users with appropriate on-board equipment to make payments to all operators subscribing to the agreement.

37. At the *contractual level*, agreements are required between operators and possible issuers to enable operators to receive guaranteed payment. Users must be able to use a payment means which is accepted by the operator for each concession area through which they travel[12]. At the present time, such interoperability depends on individual bi-lateral agreements between operators, which is a complex process. European interoperability is unlikely to be achieved solely by means of agreements of this kind. The elements of a framework for the development of interoperable European payment methods are now beginning to take shape. But they will require further work to take into account the difference between laws and regulations in the Member States, as well as to set up principles for clearing between operators and financial institutions. However, the introduction of the EURO should make electronic debiting of accounts easier and more transparent within its area. The needs of consumers must be fully taken into account in developing these agreements and consumer interest groups might be consulted.

3.2 Definition of a common minimum functionality

38. A requirement for all national systems to have the same level of functionality in order to achieve interoperability could mean some countries being forced to adopt a higher level than required for internal use, or others being required to lower their requirements. To achieve interoperability, a balance will need to be struck. In planning new systems operators will need to take into account the objectives, requirements and constraints of their systems ensuring that all potential users are offered acceptable choices for payment. These might include, for instance, opening a

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[12] Users will therefore require a contract with an issuer who in turn will guarantee payment to the operator. Operators will also require a contract with the issuer to provide the guarantee of payment under agreed terms and conditions. The issuer of the payment means may be another operator, or a financial institution.

credit account, declaration to a central data base or payment by cash, whichever is the most attractive to the users. Finally they should provide those users who wish to have interoperability with the opportunity to install on-board equipment designed to support common payment methods and common EFC transactions. Such interoperable equipment will need to have a minimum common functionality which may be higher or lower than that required for some national systems. Operators might charge if it involves them in extra costs, but economies of scale of a pan-European market might make such charging unnecessary.

39. As a general definition, the common minimum level of functionality shall comprise all the technical and contractual elements enabling electronic toll payment by authorised subscribers, with the same payment means and equipment everywhere on the networks of the operators in the system.

40. *Recommended approach.*

EU projects should work closely with the operators on the definition of a common minimum functionality taking into account, as a first priority, cross border traffic of heavy goods vehicles and long distance coaches. CARD-ME will be the forum for co-ordination between them on this issue. The definition of a common minimum functionality should form the basis for a Memorandum of Understanding (MoU) to be used for contractual agreements between operators wishing to achieve interoperability.

CEN should take into account in its current tasks the work on a common minimum level of functionality for electronic fee collection systems.

The strategy for achieving common minimum functionality should allow operators of existing non-interoperable systems to migrate to the interoperable system in a way allowing them to depreciate their investments in an acceptable way.

European and National standardisation bodies should finalise and approve current work on electronic fee collection systems including the standardisation of a DSRC link, and other systems such as those using satellite position location with cellular communication, as soon as possible.

All the actions proposed to CEN and other European standardisation bodies in this document shall be initiated through European Commission mandate M 270, the results of which will be evaluated to verify their adequacy with the recommendations of this Communication. Further actions may require a new mandate for achievement of these objectives.

3.3 Interoperability of motorway tolling systems with urban applications and other area tolling schemes

41. The concept of charging for the use of urban roads as a potential means of demand management is gaining in importance within Europe. While it is desirable to ensure that local urban EFC systems are interoperable with motorway EFC systems, there can be considerable difficulties in achieving this. The underlying objectives, requirements

and constraints for the two systems may be different and give rise to different solutions: the emphasis of motorway tolling up to now has been on cost recovery compared with the focus on demand management in urban road pricing. However, Single Market principles require certain common functionality and interoperability of the equipment used in both systems.

42. Area tolling systems using satellite location and mobile telephone technologies may seem attractive for urban applications due to the reduced roadside infrastructure required and the ability to operate without toll plazas. They are, however, relatively unproven, and interoperability with DSRC based motorway systems is still to be achieved. Dual mode equipment will almost certainly be needed if some Member States were deciding to use the satellite location and mobile telephone technologies. For systems intended for heavy goods vehicles and long distance coaches, with a distance based charging scheme, an interface with the digital tachograph should be considered.

43. In most countries little attention has so far been given to harmonisation of the requirements of different cities or of interoperability between urban and motorway tolling systems.

As a minimum, the developers of urban charging systems will need to ensure that the emerging framework for designing EFC systems, based on work in CEN, is used.

The Commission will, as set out in its White Paper on Infrastructure Charging, co-operate with cross-national groups of urban or regional authorities that are seriously considering implementing road pricing, so as to offer a co-ordinated approach between local systems and between them and inter-urban systems, and also to ensure that these groups can take full advantage of the research and technical work on EFC which has been carried out at EU level.

44. *Recommended approach.*

The developers of urban charging systems will need to ensure that the emerging framework for designing EFC systems is used to facilitate interoperability. For example, the CEN Standard Application Interface Definition should be used.

CEN should include in the standardisation of systems using satellite location technology, the requirement for retrieving data on distance travelled.

CEN should also include in the standardisation of the DSRC Application Interface Definition the input of distance data from an odometer or satellite.

CEN in co-operation with ETSI should also ensure and verify electromagnetic compatibility between the different systems implemented around the infrastructures.

An interface for transmitting distance data between the travel data recording equipment for heavy vehicles and EFC systems should be specified.

4. THE ISSUES

4.1 Non-equipped users

45. In this Communication non equipped users include those who have no equipment and those who have equipment which is not interoperable with the system in the concession area in which they are travelling.

46. Existing toll operators provide EFC as an optional service for those who do not wish to pay manually. However, the market penetration of such systems is currently small. Typically 5% of all users of tolled motorways have EFC equipment although the figure is considerably higher in Norway and Portugal.

47. Countries that have toll plazas offer a variety of payment methods. Drivers may use cash, credit or debit cards, various payment cards issued by the operator for regular travellers, and in some cases may be able to pay using an automatic machine rather than a toll booth. They may also use different payment methods on different occasions.

48. One of the serious issues facing countries introducing tolling systems for the first time is how to provide for those users who do not have an acceptable EFC payment method. Most countries consider that users have a right to pay by cash, and experience suggests that users may sometimes choose to use this method even when equipped to pay electronically.

49. Where tolling is being introduced for a specific market sector, such as heavy goods vehicles (HGVs), different issues arise. It is feasible and simple to make EFC equipment mandatory for HGVs, as they are subject to regulation and inspection. HGVs are already required to be equipped with a tachograph and EU legislation is being drafted for specifying future digital distance recording equipment. In this case, as the vehicles to be tolled represent a small proportion of the total traffic, it follows that most users of tolled motorways will remain out of the process, and will not be required to fit on-board equipment. . It may also determine the type of EFC system used.

50. Finally, it is important, especially from the enforcement point of view that EFC systems should be able to distinguish between non-equipped users who are required to pay and those who are exempt (see below). A possibility is that a Member State could require all vehicles be fitted with on-board equipment. Exempt users would fit on-board equipment that communicated their exempt status. Non-equipped users would then be violators.

51. *Recommended approach.*

There should be no direct or indirect discrimination between users on the basis of their country of origin. Within the overall constraints emanating from EU legislation, each country should be free to implement its own choice of options for the treatment of non-equipped users, according to its particular circumstances, including the road network and traffic characteristics.

The basis for fee charging should be the same for all users, although discounts can be given for options that reduce operators' costs.

Information on the payment options available to non equipped users must be readily available, e.g. via standardised signs before entering the tolling area, and also by way of telephone enquiry services.

The time required for arranging the use of a non-equipped option for payment should not be excessive in comparison with the journey time.

4.2 Classification issues

52. EFC systems need to classify vehicles in order to apply the appropriate tariff for the use of the tolled road. Most current road tolling systems use automatic equipment for classifying vehicles. Current classification systems installed in mono-lane EFC systems are accurate and reliable. They measure the physical characteristics of vehicles, such as the number of axles and height and length of the vehicle, from which the operator determines the class and thus the tariff. Classification systems being developed for the measurement of characteristics for multi-lane operation perform poorly so far.

53. Classification systems based on measured characteristics can provide only a limited range of parameters, such as length, height and width, which do not fully satisfy the emerging needs for defining classes. To resolve this issue, the use of declared characteristics, which would be stored within the on-board equipment, is being investigated. In addition to physical characteristics, it would be possible to store other parameters like emission, suspension or load characteristics which are much more difficult or even impossible to measure directly, but which may assume much greater importance in the future.

54. At present, the classes to be used for tariffing are the sole concern of each operator and are not required to be interoperable. Agreements on interoperability will need to include a common set of declared characteristics to be stored in the on-board equipment.

Agreement is currently being reached through the standardisation process on the set of characteristics that may be required for interoperable systems, as part of the CEN proposal for a standard Application Interface Definition.

55. *Recommended approach.*

Classification systems based purely on vehicle length, width and height might not adequately satisfy the requirements of all countries, nor the likely future requirements of an EU efficient charging policy. As a consequence, a common set of declared classification parameters needs to be agreed during the negotiation between operators. This should be included in the MoU between them.

EFC systems for interoperable use in multi-lane environments need to be capable of storing and processing claimed characteristics without affecting the functionality of systems using measured characteristics.

CEN should draw up a standard on classification parameters able to fulfil the requirements of the operators.

4.3 Enforcement issues

56. Enforcement forms an integral part of any tolling system. Failure to enforce payment results in loss of credibility of the systems and non-attainment of the objectives of revenue collection or traffic management. There are two main issues here:

57. Firstly, the technical performance of enforcement in DSRC systems that offer mono-lane operation is generally acceptable whereas multi-lane operation is still not adequate. These systems are required to produce proof of passage and of the fee payable under all traffic and environmental conditions. The task of detecting, classifying and registering vehicles travelling in free traffic conditions presents a complex technical challenge. Enforcement may be separated from charging, depending on privacy requirements and overall system architecture. Possible enforcement procedures include the use of data bases. In the event of failure of the toll transaction, it must be possible to identify a vehicle as a result of photographing the physical number plate or electronically by reading an electronic number plate.

58. A related issue is that roadside systems will register the passage of any vehicle that has been identified as not paying. Many users will not be obliged to pay and these users must not be enforced. EFC systems must therefore have the ability to distinguish between non-obliged users and obliged users who have not paid, in order to avoid unjustified enforcement. Any of these users may be either equipped or non-equipped.

59. The second major issue is that cross border prosecution of offenders will only be possible through international (general or bilateral) agreements that are not yet in place. An example for a bilateral agreement is arrangements between the Netherlands, Belgium and Germany on exchanges of data on drivers involved in traffic offences. Agreements are needed on mutual recognition of proof of payment and fee payable, on the exchange of information and on the administrative processes. The balance of costs incurred in carrying out these administrative processes in relation to the revenue that may be recovered is also likely to be an issue. If random checks are used, the probability of being checked must be the same for all users and must be high enough to act as a sufficient deterrent to non-payers.

60. Systems that use satellite location and mobile telephone technology to collect tolls have special enforcement requirements. Whereas in DSRC systems the technical process of detection of non-payment occurs at the same time as the toll collection process and is an integral part of the transaction, this is not possible when the vehicle position is determined by its own on-board equipment and payment involves mobile telephone technology. In systems of this type a separate enforcement system is needed.

61. *Recommended approach.*

A general framework at EU level for the facilitation of the prosecution of EFC violations across national borders should be explored by the Commission, complementary to or as a basis for bilateral agreements.

National authorities should be encouraged to establish further links between tolling enforcement agencies and national registration data bases to facilitate enforcement across borders and of violators from other Member States.

Toll operators and enforcement agencies should be encouraged to adopt common procedures for the exchange of evidence of violations and of data relating to enforcement. Evidence exchanged should comply with the regulations and the requirements on privacy (see §4.5).

The electronic legibility of licence plates should be improved. Research on this could be part of the 5th Framework RTD Programme.

Toll system purchasers, and prospective purchasers, should be encouraged to promote further research, development and testing of tolling systems, with particular attention to the enforcement subsystems for multi-lane tolling. This should draw on relevant work within the EU RTD programmes.

4.4 Issues concerning data protection and system security

62. As users are offered the possibility of travelling across Europe using interoperable payment methods and on-board equipment, the risk of fraud inevitably increases. Users will enjoy the benefits of unhindered travel on longer journeys through various concession areas but this, in itself, provides greater opportunities for organised fraud. The security mechanisms designed to protect operators and regular car users in a local area may not be appropriate for Trans-European traffic.

63. Fundamental work within MOVE-it[13], CARDME and Working Group 1 of CEN Technical Committee 278[14] has been developing the security framework required to support these interoperable systems. Issues such as the acceptability of arrangements on protection of data from other Member States, liability in case of failure, disputes and burden of proof, and the certification of equipment, need to be taken into account in framing contractual agreements. It is important that effort is focused on defining and reaching agreement on approaches to the common data protection domain and on migration paths. Those paths could lead to general agreement on the need to minimise the risk of non interoperability from different security requirements of individual operators. Any decisions on the privacy and security aspects of interoperable EFC systems will need to be in line with general principles of IT (Information Technology)

[13] EU RTD project, acronym stands for Motorway Operators Validate EFC for interoperable transport

[14] Technical Committee on Road Transport and Traffic Telematics

data security and personal privacy as well as national legislation and the EU Directive on Data Protection[15].

64. *Recommended approach.*

The presumption should be that the general rules on data security and protection will apply, and will be sufficient unless there is a convincing case otherwise.

National authorities and toll operators should however be encouraged to consider if any additional measures are needed. Provisions for liability, insurance and risk acceptance resulting from failure in data protection should be integrated in the contracts between parties.

In-depth studies must be encouraged about the legal and practical implications for the protection of privacy, and about data which may arise from the use of Telematics applications in EFC systems.

4.5 Privacy issues

65. There is a general presumption that the privacy of users will be preserved by toll systems. General privacy requirements are included in existing national and European legislation but the particular requirements of users in relation to EFC systems are not yet subject to specific legislation and are still open to debate. It may be very costly, even if it is possible, to meet all the privacy requirements of all the Member States.

66. For example, deferred payment has been suggested as a way of handling non-equipped users in multi-lane tolling systems. Users would be permitted to pay tolls within a limited time such as 24 hours before or after using the motorway. This would mean that the operator would need to store the identity of users who have not paid by the time of leaving the motorway for this period of time before either confirming payment or triggering the enforcement process. The legality of such a scheme has not yet been tested in the courts, but there is evidence from other applications and other locations that the principle of such a procedure is feasible.

67. Some users may desire an anonymous method of payment. This means that, not only is the user identity not revealed to a third party, but also the operator is unable to identify the user except as part of the process of enforcement of non-paying users. Cash payment currently ensures anonymity. Electronic money will soon become available and could offer similar anonymity if accepted by operators as a payment means. The issuers of general purpose electronic money would have to be the financial institutions but many operators are reluctant to accept the involvement of financial institutions, as the issuer handles very large amounts of money which are critical to the business of the operator. A possible compromise acceptable to operators but less convenient for users would be the use of sector specific electronic money which could only be used to pay for services provided by toll operators and for which

[15] EU Directive on the protection of individuals in regard to the processing of personal data of 23.11.1995 OJ L 281

they themselves could be the issuers. Participation of consumer interest groups could help in the search for an appropriate solution and ensure its general acceptance.

68. *Recommended approach.*

The Commission will examine the EC Directive[16] *on privacy to check whether it adequately covers the privacy aspects of EFC systems or whether specific legislation is required. In depth studies of the legal and practical implications for the protection of privacy, which may arise from the use of EFC, should also be encouraged.*

5. PREREQUISITES FOR CONVERGENCE

69. Given the present differences in systems technologies, levels of deployment and pilot schemes throughout the EU, a strategy for convergence to pan-European interoperability must envisage several stages of migration from the present position : EFC systems are deployed on a large or a small scale in some countries, while no systems are deployed in other countries and several countries have experimental systems or actively plan systems. The existence of these different stages of development means that migration options must enable an appropriate level of interoperability. This level will be reached through successive changes to equipment and to procedural and contractual agreements leading to interoperability with increasing functionality and covering a widening geographical area at minimum cost to operators and users. A first step will be the completion of work within EU-funded projects, which should enable the existing CEN pre-standard on the DSRC link to be converted into a full standard..

70. From a theoretical point of view there is something to be said for defining a target system for the future and then converging as economically as possible to this target system. In the long term this may be possible, but, in the short term, the expectation is that each country will have its own national system with sufficient common functionality to enable drivers to pay tolls electronically in at least several countries without needing to change equipment.

71. Countries that have existing tolled motorways, whether with manual or automatic payment, have built toll plazas with many lanes. Normally only one or two lanes at each plaza are equipped for automatic toll collection. Technical interoperability of a sort may be possible by installing another system in one of the existing lanes if the two systems are compatible and do not cause mutual interference.

72. The situation in countries that do not have existing toll plazas is quite different. The absence of toll plazas means that in most cases multi-lane operation will be essential and the problem becomes one of ensuring interoperability with the single lane On-Board Equipment in use in other countries. The technical problems may not be insuperable but the operational problems of providing anonymity when required and avoiding financial loss by fraud are at least as difficult as for the existing systems.

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[16] EU Directive on the protection of individuals with regard to the processing of personal data OJ L 281 of 23.11.1995

73. Anonymity is most easily achieved by cash payment as in existing systems and, if this solution is advocated for new multi-lane systems, a means of cash payment for motorways without toll plazas must be devised. The distinction between anonymity when the movements of a vehicle are not known to anyone but the driver, and privacy when the vehicle movements are known to the system operator but can be legally protected, is important.

74. The avoidance of fraud presents escalating problems as the number of users and the number of interconnected operators offering interoperability increases. For this reason it could be efficient to set up a step by step interoperable operation starting with some groups of operators and issuers in a limited area.

75. In developing strategies for convergence it will be necessary to adopt a phased approach. It is recommended that in the first phase, we concentrate on interoperability for heavy goods vehicles and long distance coaches, for which the equipment may be less price sensitive than for private users and for which issues of privacy and enforcement may be easier to solve. Another is concerned with the minimum functionality concept recognising that the majority of private vehicle owners will rarely travel outside their own country. The project CESARE and the Euro-regional projects like VIKING and CENTRICO will help to define this strategy. CARD-ME will be the forum for co-ordination between them on this issue.

6. CONCLUSIONS

76. EFC systems provide a flexible tool to implement EU, national, regional and local policies for charging road vehicles for the use of infrastructure, either for recovery of costs, or for traffic management purposes. The Council has agreed that an appropriate level of interoperability between EFC systems must be achieved, and has called on the Commission and Member States to accelerate work to identify and remove obstacles to interoperability of EFC systems. It has also called on Member States when replacing, upgrading or introducing EFC systems, to do so in accordance with the strategy for convergence.[17] This will require a phased approach. This Communication sets out the first phase of such a convergence strategy.

77. **Main actions in the first phase** (1998 to 2000) will be based on the following key assumptions:

i. priority will be given to interoperability of EFC systems for HGVs and long-distance coaches used on the Trans-European Road Network (TERN). This will need to provide the means to implement decisions on EU wide charging policies. The Commission's White Paper proposed application to commercial operators of greater cost-related charging, differentiating by time, vehicle characteristics, route and so on, by 2004.

ii. interoperability between urban and inter-urban applications also needs to be given priority in the development and implementation of EFC systems

[17] Present plans in some Member States for replacing, upgrading or introducing EFC systems already go in this direction

iii. an open-system architecture will be necessary, capable of responding to policies developed at EU or national levels, of integrating further operational and technological developments, and enabling commercial opportunities. Such an architecture would require consideration of dual or multi-mode equipment which would permit the use not only of DSRC technology but also of GNSS-based systems or other technology, where appropriate, in response to policy need or operational convenience. The architecture should also allow the potential exploitation of EFC-based technologies for traffic management and value-added services.

Achieving these objectives will require action by the Commission, the Member States, local and regional authorities, concessionaires and by the standards bodies.

These actions will be :

a) to define and agree a **common minimum level of functionality** at the EU level (ie the basic features needed in order to achieve interoperability, e.g. capacity to distinguish types of vehicle, methods and arrangements to effect payments etc) , reflecting policy and operational requirements. This will be based on work done within EU-sponsored projects under the 4th Framework R&D Programme particularly on Transport Telematics Applications and of the Trans-European Network – Transport Programme. Any additional actions will be undertaken in the 5th Framework Programme.

b) to enable these common functions to be performed, **CEN** (Comité Européen de Normalisation) should complete its work on EFC on the basis of Mandate 270 from the European Commission, developing, validating and adopting standards on DSRC and other areas, where appropriate. These standards should enable multilane operation and the introduction of traffic management and other value-added services, using the same technology.

c) The Commission will help all interested parties to complete the work on **contractual interoperability** by promoting the signature of a Memorandum of Understanding between them, based on an EU framework agreement.

d) The Commission will explore ways to facilitate cross-border enforcement and to adequately cover privacy and data-protection issues.

e) The Commission will co-operate with cross-national groups of urban or regional authorities considering the introduction of road pricing, so as to offer a co-ordinated approach between local systems and between them and inter-urban services.

78. The Commission will produce detailed proposals based on this approach and the results of the work currently underway at EU, national and regional levels. It will then put forward proposals for actions in subsequent phases on the basis of the results obtained in the first phase.

79. In the meantime it recommends that decisions by national or local administrations or private concessionaires on EFC systems should be based on this Communication.

80 Failure to achieve interoperable EFC systems will cause disbenefits for the European citizens, especially long distance drivers who will be confronted with artificial borders between the different Member States, obliging them to use different cards or onboard units, or to stop and pay cash at toll booths. European industry will loose a competitive advantage on the world market, due to the proliferation of proprietary systems, and the resulting absence of economies of scales. Finally, road operators will also suffer because of increased equipment costs and restriction on their freedom of choice.

81 The Commission therefore asks the Council and the Parliament to endorse this first stage in a convergence strategy for EFC systems in Europe and the assumptions on which it is based.

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