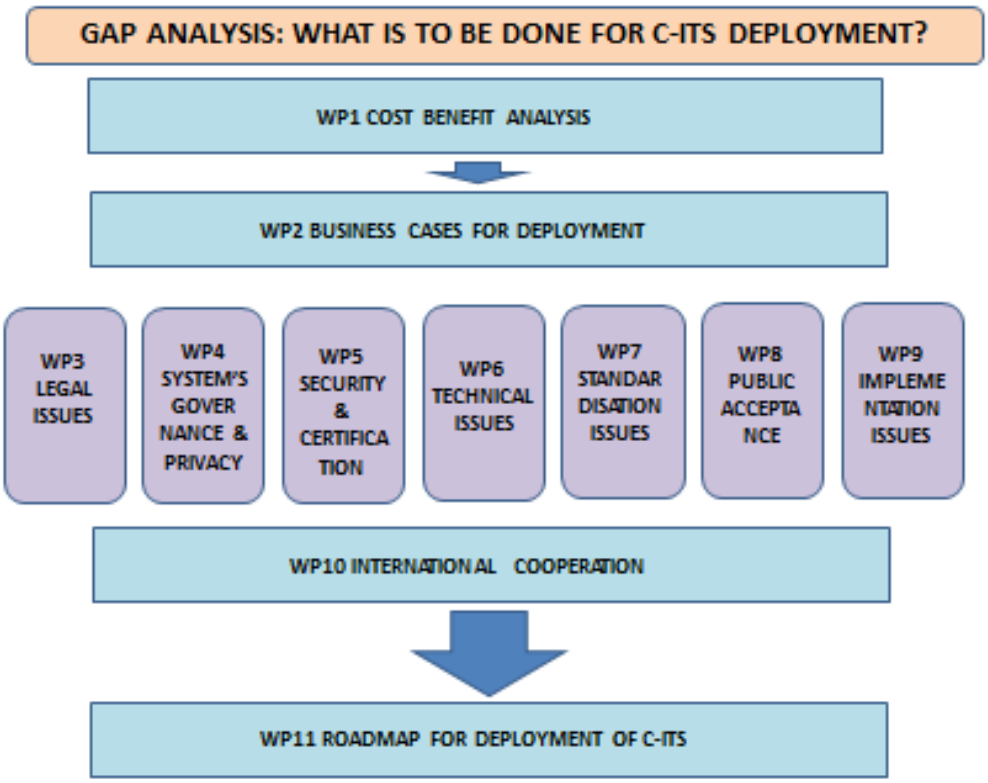
GAP ANALYSIS: WHAT IS TO BE DONE FOR C-ITS DEPLOYMENT?
WP1 COST BENEFIT ANALYSIS
WP2 BUSINESS CASES FOR DEPLOYMENT
WP3 LEGAL ISSUES
WP4 SYSTEM'S GOVER NANCE & PRIVACY
WP5 SECURITY & CERTIFICA TION
WP6 TECHNICAL ISSUES
WP7 STANDAR DISATION ISSUES
WP8 PUBLIC ACCEPTA NCE
WP9 IMPLEME NTATION ISSUES
WP10 INTERNATIONAL COOPERATION
WP11 ROADMAP FOR DEPLOYMENT OF C-ITS

This paper presents an overview of the work programme to be undertaken for the development of a shared vision and a deployment strategy for C-ITS in the EU in the context of the Platform to be established by the Directorate General for Mobility and Transport of the European Commission. It is structured as work packages mapping the gaps to be addressed in order to achieve effective deployment.

Cooperative ITS (C-ITS or cooperative systems) is a group of technologies and applications that allow effective data exchange through wireless technologies among elements and actors of the transport system, very often between vehicles (vehicle-to-vehicle or V2V) or between vehicles and infrastructure (vehicle-to-infrastructure or V2I). However, for the purpose of the work to be undertaken by the forthcoming platform and more in general in view of a roadmap for the deployment of C-ITS in the EU, C-ITS are to be understood as a broad concept which is not limited to V2V or to V2I communication but also includes C-ITS applied to vulnerable road users such as pedestrians, cyclists or motorcyclists.

It is generally agreed that the deployment of C-ITS is an evolutionary process that will start with the less complex use cases benefitting different actors. In order to avoid a "silo" approach it is important to bear in mind that a single event may generate several processes where information, and hence data, is transferred for different purposes and could thus lead to different C-ITS applications which in turn might use different communication technologies. Furthermore, the scope of analysis is not restricted to highways or long distance corridors but also includes urban areas and secondary road networks.

With the objective of having a holistic approach, the exercise is designed as "technology neutral", and therefore, does not exclude any type of communication technology, be it DSRC or cellular based. Furthermore, some applications could also benefit from RDS-TMC / DAB-TEPG broadcast, and the second generation of Galileo could also play a significant role in the future.

Finally, the focus is put on C-ITS though there is a natural link with progress towards vehicle automation. The implications and interaction that exist between both fields cannot be ignored and will be considered in the analysis.

WP1 "Cost Benefit Analysis" proposes establishing a matrix of different geographical environments and time horizons, in order to identify for each of them the most likely applications to be deployed in different time frames. In addition the cost benefit analysis needs to consider how applications can benefit different categories of users as for many C-ITS applications there is a potential benefit for the user as an individual, as well as a potential benefit for the society, that goes beyond the addition of the individual benefits.

WP2 "Business Cases for Deployment": The deployment of C-ITS requires the involvement of stakeholders from different industries and public sector actors, and cannot just rely on public funding. The decision to deploy Cooperative Systems has to be based on sound and

convincing business cases for all the actors along the value chain, and hence which give sufficient confidence to the core stakeholders to invest.

WP3 to WP9 deal with the main issues to be addressed (legal, security & certification, system governance and privacy, public acceptance, implementation, technical or standardisation issues), most of them are enablers or barriers that hinder the deployment of the C-ITS applications.

In order to facilitate the deployment of applications which are already close to the market it would be highly beneficial to identify common enablers and barriers for the different scenarios.

WP10 looks at the on-going **International Cooperation** between the EU, the US and Japan.

Finally, **WP11 "Roadmap for Deployment of C-ITS"** constitutes an overarching work package integrating all the previous elements for the development of a roadmap for the deployment of C-ITS in the European Union. The roadmap considers options for an introductory strategy for C-ITS.

Work Package 1: COST-BENEFIT ANALYSIS

Because the C–ITS sector is relatively young with only a limited experience of trials and pilot deployments from which information can be drawn there is a shortage of reliable evidence on the costs of services and components, as well as on the qualitative and quantitative nature of the associated benefits which will depend also on the overall objectives behind the deployment of C-ITS (road safety, improvement in the transport network management, or sustainability issues). We need to know, *inter alia*,

- what services are likely to be available in the short, medium and long-term ?
- what can the services deliver ?
- what are the likely benefits, their nature (i.e. real monetary returns or socio-economic gains) and their estimated values ?
- what are the costs estimated for different services and applications?
- to what extent do benefit or cost values change in different environments, in particular urban, inter-urban or rural locations ?
- how different are the business case regimes for light vehicles and the commercial freight and passenger sector ?
- how do the costs and the benefits vary with changes in the degree of penetration of equipped vehicles, the coverage of road networks with roadside devices, and the degree of equipment of other users of the transport network such as pedestrians, cyclist or motorised two-wheelers?
- to what extent are costs or benefits marginal i.e. the deployment of one system opens the way to faster or greater benefits or/and reduced costs for later services
- what are the cost/benefit implications of different deployment scenarios in the context of equipping vehicles using nomadic devices or smartphones?

Answering these questions will depend on the availability of a framework for quantifying the benefits and costs analogous to the processes that are used for mainstream transport. It might therefore be prudent to begin this work with a general scoping study to identify and give a short description of completed or current C–ITS benefit/cost studies in the EU and key overseas regions such as the USA. In this respect, the C-ITS Platform is expected to closely cooperate providing relevant input to a study the European Commission (DG MOVE) intends to launch.

The results of this study will provide elements for the impact assessment to be carried out by the European Commission to justify with sound data on economic, social , environment and other fields justifying or not, the deployment of C-ITS in the EU.

Work Package 2: BUSINESS CASES AND BUSINESS MODELS

In the last 18 months or so there has been a lot of discussion about the need for C-ITS business cases and business models but very few studies have been published, and there is very little evidence upon which to try to build a viable model. Part of the difficulty is the overlap between the private and public sectors and the lack of comment – by both parties – concerning what costs they expect to have to meet and the corresponding equipment or infrastructure that will be provided.

Estimating prices for services, and selecting what will be provided and when, is also complicated as in many cases the same combination of in-vehicle equipment, roadside infrastructure and data can deliver either a safety service or a lifestyle/comfort service and motorists broadly speaking are more prepared to pay for the latter than the former. Pricing is also difficult as traditionally costs of such devices have been 'bundled' into the price of a vehicle and it is not clear whether for C-ITS users will opt for this approach or prefer a 'pay-as-you-go' model. The traditional approach to assembling a business case is broadly as follows:

- Set out how the proposed project or/and investment helps the organisation to achieve its objectives
- Review the evidence that supports the decisions to commit resources
- Set out the options for delivering the proposed project or/and investment
- Review costs and risks
- List critical success factors
- Outline the consequences of a 'do nothing' scenario

Writing a single business case for C–ITS deployment would be very difficult. Not only can we expect an extensive overlap of actions of both the public and private sectors, but also these two sectors have very different objectives. This has hampered at present an agreement on a unified strategy for both across Europe. A simple way forward might be to jointly define agreed business models around very specific services/applications, in which all the actors in the value chain find their interests presented in a convincing way.

We can identify a number of systematic steps to collect evidence to build test business models and then to use them to develop marketing strategies. The private and public sectors will follow similar processes, but in most cases the public sector will be dealing with a mix of real monetary costs and socio-economic estimates of revenues (for example an investment of €X in roadside infrastructure and operation and maintenance might be expected to save Y lives year which enables a benefit/cost figure to be calculated) whereas the private sector will deal exclusively in real money costs and revenues.

1. Define what is being offered to users / customers
2. Define who are the users / customers
3. Identify the possible delivery channels
4. Decide how to find / keep / satisfy the users / customers
5. From 1-4 define one or more value propositions – what is to be supplied on the one hand, and what the users / customers have acknowledged and accept that they have to pay for the value in real terms or as part of governmental social spending on the other. In essence this becomes the business case.
6. Following step 5 define what needs to be done by the supply side to provide the services or products using what resources and whether partners or sub-contractors are necessary?
7. From step 6 sketch alternative marketing and pricing strategies in order to calculate revenue models
8. Test alternative delivery and marketing scenarios to explore how to drive down costs and pull up revenues

Clearly step 5 depends strongly on the availability of cost-benefit data.

On the basis of the results of the study on Cost Benefit analysis to be undertaken in WP1 and taking into account the steps presented above the Platform will develop a set of business cases for the deployment of C-ITS. It will also have to bear in mind the need to address the expectations of a large variety of stakeholders with very different roles through the value chain.

Work Package 3: OPEN LEGAL ISSUES

The deployment of C-ITS brings an important number of legal questions regarding liability, privacy or road traffic legislation related to future vehicle technologies. Since privacy issues are intimately linked to data ownership and management of the data, these aspects will be dealt in the context of WP 4 "Governance of the System and Privacy".

3.1 Legislation / regulation requirements

Cooperative Systems go hand in hand with an increase in vehicle automation, meaning that there is an increase in the functions carried out by the vehicle and not by the driver. This issue has important implications both on the attribution of liability and compatibility with existing legislation.

3.2 Need for a common European framework on liability

As transport technology advances the issue of who is liable in the event of a crash will potentially become more complex. The question of how liability would be allocated in the event of C-ITS system failure will be important in providing certainty to drivers, manufacturers, insurers and road managers. While it is expected that the number of crashes would be reduced significantly in a fully C-ITS equipped environment it is likely that some crashes would still occur perhaps with some C-ITS related reasons such as:

- Data communication failure or interference
- Conflicting or erroneous warnings being provided to drivers
- A driver failing to respond to a warning received
- Driver over-reliance on the technology, and hence reducing concentration as a consequence of extended automation of driving

Additionally, a number of scenarios could be imagined involving either the failure of the technology, limitations of the technology in different conditions, or problems in the interaction between the driver and the technology.

The more complex or “non-overridable” an ITS application or service is, the more complex are the related liability issues. There will therefore be especially significant liability implications when C-ITS applications progress from performing advisory functions to executing autonomous actions in vehicles. In particular, the use of retrofitting or after-market devices is likely to require special attention and has implications for manufacturers’ warranties.

The C-ITS platform will take stock of studies on the legal framework in the EU in order to provide recommendations on liability issues.

3.3 Compatibility with existing legislation (the Vienna Convention)

Under the current UN legislation the driver must at all times be in full control of the vehicle. Since Cooperative Systems go hand in hand with an increase in vehicle automation and advanced driver assistance systems, this means that for the deployment of C-ITS to become a reality on a wider scale, there would be a need to amend the Vienna Convention[1]. Work has been on-going to amend the text of the Convention and a compromise solution was adopted on 24 March 2014 by the UNECE Working Party 1 on Road Safety in relation to allow the possibility of vehicles where the driver is not in full control of the vehicle, provided that the systems can be overridden or switched off by the driver. The amendment proposal is now referred for decision in the UN Inland Transport Committee.

This new regulation would allow vehicles with higher levels of automation on the road (both for testing and use), but would still require a driver in the loop able to take over control at any time. This means that (fully) automated driving on public road is still not permitted.

The Platform will need to assess and provide recommendations on legal issues and in particular regarding two standing issues:

- Following the amendment of the Vienna Convention, what further steps are needed to remove legal obstacles for the new technologies?
- Are there remaining obstacles or updates needed in the international regulatory framework on type approval?

[1] Contracting parties can circumvent the Vienna Convention and adopt other rules on their national territory but without the amendment there would still be legal problems for international traffic.

Work Package 4: GOVERNANCE OF THE SYSTEM & PRIVACY

4.1 Organisational Issues

The deployment of C-ITS will rely on a large number of actors of very different nature. To ensure proper functioning of these systems throughout the EU, independently of the level or nature of deployment of C-ITS in the different Member States, it would appear necessary to establish some basic organisational principles, in particular for those aspects linked to interoperability, data management and system reliability. Privacy aspects that are intimately linked to data ownership and data management are also covered by this work package.

4.2 Data management

C-ITS services will produce enormous amounts of data that will have to be collected, transmitted and processed. This will imply a complex data management and exchanges that will exceed any of the current situations. Ensuring quality, traceability and reliability of data throughout a secure value chain will therefore become a great challenge.

The C-ITS Platform is expected to look at the possible alternatives for ensuring reliable data management throughout the C-ITS services, and eventually produce recommendations on what type of future actions need to be undertaken by both private and public stakeholders in this respect.

4.3 Ensuring continuity and minimum quality of services throughout the EU

Quality management and continuity of services are essential for the deployment of C-ITS. It is important to ensure that a vehicle of Brand X communicates with another vehicle of Brand Y, and that both communicate consistently with the road side equipment or other infrastructure devices, irrespective of whether they are in a Country A or a Country B.

While it can be expected that in a first stage C-ITS services will be introduced as "ITS islands" or "hotspots", where these services will be available in isolation, the ultimate goal is to make these "ITS islands" converge to offer a continuous and seamless service. Efforts will need to be focussed on reliability of ITS services by improving consistency along the whole value chain, irrespective of the services and the regions where they are being operated.

This will inevitably involve formalised coordination, for instance establishing a "service level agreement". The C-ITS Deployment Platform should analyse what kind of coordination mechanisms could be established, and provide recommendations in this respect.

4.4 Data ownership

C-ITS are based on three pillars: communication, positioning, and processing of data. Data is, therefore, a key issue to providing C-ITS services. Many questions arise in relation to data

ownership. If probe data (data normally generated by the vehicle) remains available only to vehicle manufacturers, a real deployment of C-ITS will not occur:

Should the providers of different applications have access to these data in order to offer their services? Under which conditions should this eventually occur? How should the driver /owner of the car have a voice in the ownership discussions? What is the situation when data is captured by infrastructure? What would be the situation if a C-ITS service is based on a nomadic device for the communications channels?

In particular, access to data is one of the most critical issue for the development of C-ITS. Different possibilities should be explored having in mind their effectiveness: schemes to encourage data sharing, regulations on data sharing and legally binding definitions concerning data ownership.

The C-ITS Platform is expected to analyse these issues, and provide recommendations regarding future actions to be undertaken.

4.5 Privacy

C-ITS applications will generate enormous amounts of data that could potentially have a variety of uses. This data is likely to be in many cases personal/vehicle data, or data which is capable of being linked indirectly or directly to a person or to a vehicle, therefore it could present challenges in terms of security and privacy.

Location and route information collected from vehicles allows the development of new services that may be personalised for travellers, but unauthorised access to data bases storing the information and hackers can compromise driver privacy by identifying residences or mobility patterns. This is why it is necessary to clarify which data is pushed/pulled from the vehicle, exchanged with other vehicles and/or infrastructure, and from infrastructure to infrastructure, for what purposes, and under which conditions. The issue will need to be handled carefully: its complexity rests with the wide range of actors involved in accessing and/or managing these data in C-ITS.

The key question is the extent to which C-ITS information will make individuals (such as drivers or registered owners) reasonably identifiable.

Different data protection legislations exist, at European Union and national level. In this respect, two legal instrument are relevant at European level: Directive 95/46/EC on the processing of personal data and Directive 2002/58/EC on the protection of privacy in areas were electronic communication technologies are used for an ITS application. Furthermore, the Commission has recently proposed a new legal framework on data protection, containing

stricter and clearer rules, in the form of a Regulation directly applicable and thus contributing to a more homogenous legal landscape in practice.

The C-ITS Platform will look into these issues in view of developing recommendations for further actions at European level if necessary, for instance privacy by design measures and/or privacy impact assessment.

Work Package 5: SECURITY & CERTIFICATION

We live in a connected world so in considering the deployment of C-ITS cyber-security of the system is a pre-condition. In this respect a detailed security framework, impeding hacking, is needed for the reliability of the system. There are two main issues regarding security: security of the in-vehicle systems and security of communications. Standardisation activities for both are already under way namely in ETSI TC ITS[2] and IEEE[3] . How the C-ITS security links with general cyber-security strategy is also important.

Regarding security of the in-vehicle system the main concern is avoiding intrusion from unauthorised actors. Tamper-proof hardware security modules are needed for the different part of the systems and standardised solutions are needed. Protection of sensitive personal data stored in the IVS[4] needs personal attention.

Another important issue is how to ensure that the in-vehicle C-ITS stations and their interfaces remain secure whilst allowing access to in-vehicle resources. Partition of the systems may be a solution, allowing particular security protection for those services and data that needs reinforced attention. Buffers with standard interfaces allowing secure exchange of information with service providers without needing to access to in-vehicle data, components and systems (CAN buses) could also be envisaged.

The vast majority of the work undertaken in this field has been in relation to V2V communication, and V2I is probably lagging behind. These systems should issue both short-term and long-term certificates, and therefore include message signatures, pseudonyms and public key infrastructure (PKI).

Standard solutions have been developed for secure communications, but definition of governance and specification of the roles of the different entities is incomplete. The need to establish a Certification Authority is also being debated and if so how should it be designed (centralised *v* decentralised? public *v* Public-Private Partnership?). Whatever solutions are adopted, they need to be scalable as lower volumes will be required initially which will scale up as wider deployment of C-ITS takes place.

Work undertaken by EU funded projects and by the C2C Communication Consortium has covered a substantial part of the necessary preparatory work, notably in relation to "ID management". However, there are still open issues in relation to "misbehaviour detection":

[2] European Telecommunications Standards Institute, Technical Committee Intelligent Transport Systems
[3] Institute of Electrical and Electronic Engineers
[4] Initialisation Vectors: arbitrary number that can be used along with a secret key for data encryption

- How do we prevent a vehicle from injecting incorrect data into the C-ITS system? How do we organise a revocation scheme?
- Do we need to verify all the information packages produced? Should there be a discrimination of the packets to be verified? How should this discrimination be?
- Do we need to attach a certificate to all these packets?

Taking one or another option may have a big influence on the risk of congestion in the system.

A key aspect of security and certification concerns retrofitting and nomadic C-ITS devices, and how to ensure that any such actions are as secure as original fitting.

The C-ITS Platform is expected to look into these issues and formulate appropriate recommendations in view of establishing a robust security and certification scheme that allows the deployment of C-ITS in the European Union.

Work Package 6: TECHNICAL ISSUES

In the context of this work package a variety of technical issues that could be both, enablers or barriers for the deployment of C-ITS will be addressed.

6.1 Frequencies

Electronic road charging and the enforcement of the digital tachograph rely on the 5.8 GHz frequency. This frequency is known as dedicated short range communication (DSRC) and is specified in CEN Standard EN 12253. This frequency is key for the implementation of the Interoperability of Electronic Fee Collection Systems Directive (2004/52/EC), and the Decision on the Definition of the European Electronic Toll Service (EETS) and its technical elements (2009/750/EC). On the other hand, the 5.9 GHz frequency is reserved for safety related applications (ITYS-G5) through a Commission Decision (2008/671/EC). Hence, this frequency is critical for the deployment of C-ITS.

Nowadays, both frequencies are coming under pressure from other industries which would like to use them for various types of broadband services. While respecting all the existing agreements at international level, it is essential to ensure that future Radio Local Area Network applications do not interfere with existing ITS services and put at risk the deployment of C-ITS.

The C-ITS Platform should look into this issue and produce recommendations to ensure that the deployment of C-ITS is not impeded by future developments in the radio spectrum policy.

6.2 Hybrid communication

The provision of C-ITS requires cooperative technologies allowing vehicles to communicate with other vehicles and elements/users of the transport system, such as the roadside infrastructure, to share data about the traffic status and immediate road environment. These communication needs can be satisfied by different technologies:

DSRC refers to a form of wireless communications intended for transport applications. It works as a high speed broadcast over a limited range and is therefore suitable for active safety applications. The introduction of ITS G5 is currently led by the automotive industry.

Cellular mobile communications (future 5G, the new 4G (LTE) and the established 3G) provide high-bandwidth data communications for mobile data terminals. Existing vehicle telematics systems use these networks to exchange data between vehicles and their remote information services. With proper connectivity settings event triggered messages (DENM[5])

[5] DENM: Decentralised Environmental Notification Message

can be sent from one vehicle to another over the broadband network very quickly[6] and with a high quality of service. Position and direction messages (CAM[7]) will, on the other hand cause congestion of the signalling channels in wide area cells and are not recommended to be carried by mobile networks.

It looks like the deployment of C-ITS, at least in its first phases, should rely on hybrid communication depending on the type of C-ITS services to be provided. The uptake of some services could be greatly accelerated if nomadic devices such as smart phones were used to deliver C-ITS messages to drivers with unequipped vehicles. The Platform is invited to look into these issues and provide recommendations to be incorporated in the development of the roadmap for deployment.

6.3 Decentralised Congestion Control

For the proper functioning of the C-ITS services it is important to prevent the communication channels from being congested by incoming/outgoing messages. Despite the fact that Decentralised Congestion Control (DCC) is an issue mainly relevant when there is already a relatively high level of C-ITS penetration it has to be considered in view of the deployment of C-ITS.

Among the aspects to be explored in the context of the Platform is the possibility of establishing priorities for messages depending on the type of C-ITS services to which they are linked.

6.4 Interfaces for access to services & vehicles resources

In order to promote opening up of markets to free and undistorted competition for the benefit of the consumer, it is necessary to create an environment where service providers can connect safely to resources existing in the vehicle to provide a wide range of services. In this respect there are many approaches towards defining a platform for the provision of telematics services in vehicles and the concept of platform architecture can encompass very different aspects in different contexts.

In the context of the eCall inter-institutional negotiations (type-approval), the European Parliament has requested the Commission to work further on …"an interoperable, open-access, secured and standardised platform for possible future in- vehicle applications or services. As this requires technical and legal back-up, the Commission should assess without delay, on the basis of consultations with all stakeholders involved, including vehicle

[6] In 3G less than 350ms, in 4G less than 150ms, and further improvements are expected in 5G standardised by 3GPP (which is not the same as ITS G5 5.9 GHz WLAN)

[7] CAM: Cooperative Awareness Messaging

manufacturers and independent operators, all possibilities to promote and ensure such access to services and, if appropriate, put forward a legislative proposal to that effect."

Considering access to services plays a critical role in the deployment of C-ITS, the Platform is expected to carry out an in-depth and balanced assessment of this issue and provide recommendations, supported by relevant stakeholders, to the Commission for future actions to be developed.

6.5 Life cycle management

Despite the fact that efforts in current projects and initiatives are focussing on Day-1 applications it is critical to ensure that the technical C-ITS implementation for Day-1 can also be applied for the next generation systems ("Forwards compatibility"). The same holds true that future implementations will need to be compatible with Day-one applications ("Backwards compatibility"). The consideration of life cycle management is vital to ensure a real sustainable deployment of C-ITS.

The C-ITS Platform is expected to provide a thorough review of this issue to avoid its becoming a barrier for the future deployment of services.

Work Package 7: STANDARDISATION ISSUES

One of the core issues linked to C-ITS is interoperability between the different services, systems and technologies at stake, which leads to the need to develop the necessary standards. Getting a good understanding of what is being standardised, who is working with what and the importance and impact of the standardisation for C-ITS stakeholders is basic in view of its deployment.

Within ITS standardisation there are three bodies of special interest – CEN TC 278[8], ETSI TC ITS[9] and ISO 204[10].. The first two have established an ITS Coordination Group to ensure ongoing coordination of their standardisation activities[11]. To ensure work progress and cooperation in standards development the European Commission has created the so-called mandates. These aim to ensure that standards are developed within certain high focused areas. In this respect, under Mandate M/453[12], ETSI and CEN together with relevant industry stakeholders have developed the basic set of standards (Release 1) to allow Vehicle to Vehicle and Vehicle to Infrastructure communication for Day-1 applications, thus enabling C-ITS to become a reality.

The following key issues need to be considered when facing standardisation for C-ITS:

1. The C-ITS Architecture needs to ensure interoperability at all layers, lower (e.g. convergence with IP communications[13], allowing large scale deployment of C-ITS services and convergence with the Internet of Things and smart cities' needs) and higher, allowing deployment of different services and applications, safety and non-safety critical (that will need to define Quality of Service).
2. There is a need to define the roles and entities in C-ITS services in the full value chain, which will determine user requirements and data flow interfaces for Release-2 of the standards, including contribution from all actors, such as road operators, traffic management authorities, service providers.
3. We need a comprehensive set of standards to ensure interoperability and compatibility with other systems operating in adjacent spectrum (e.g. DSRC systems for toll collection).

[8] CEN TC 278: CEN Group responsible for managing the preparation of standards in the field of Intelligent Transport Systems (ITS) in Europe

[9] ETSI TC ITS: European Telecommunications Standards Institute,Technical Committee Intelligent Transport Systems

[10] ISO 204: ISO Group responsible for the overall system aspects and infrastructure aspects of intelligent transport systems (ITS), as well as the coordination of the overall ISO work programme in this field

[11] It has to be noted that most of the standardisation work on mobile networks is done in 3GPP on a global level and then confirmed by ETSI and other regional standardisation bodies.

[12] Mandate 453: It is considered to be the main mandate to support part of the ITS Action Plan and ITS Directive. It describes 69 areas of work for a complete Cooperative System, and requests a minimum set of standards to deploy C-ITS

[13] IP communications: Principal Communication Protocol on Internet

4. Test suites and standards to determine overall conformance assessment of equipment and systems are needed, as well as plug tests to check interoperability and production of guidelines for adequate implementation of the standards.
5. Awareness and promotion actions have to be considered so that the standards are used.
6. Finally, alignment with international activities, agreement on common terminology and semantics, common assessment methodologies, gap and overlap identification, and ensuring minimum harmonisation, should also be considered.

What has been achieved so far?

The scope of what has been standardised is very broad and covers more or less the complete architectural hierarchy in various usage domains. This includes among others:

- Architectures for C-ITS services
- Various radio communication systems
- Formats and structure of message systems and transport
- Security and privacy technologies and system aspects
- Interfaces and reference points
- Database technologies and data file structures

With regard to Mandate 453 it looks as if the work undertaken so far has been mainly car-centric and related to road safety (CAM, DENM, 5.9 GHz channel congestion control[14]). However, when thinking about deployment of cooperative systems in Europe, road safety would not be the only driver nor should car drivers be the only users to be taken into account. The core technology for the whole range of benefits of C-ITS is expected to be available in cars as well as in personal devices. Infrastructure will be partly dedicated to C-ITS, and partly based on cellular networks. There is certainly a benefit in developing C-ITS-specific features of cellular networks in order to deliver the not-safety-critical applications, satisfy the needs of authorities and road operators and open the system to a large scope of new services, many of them not existing today.

European organisations cooperate closely with American and Japanese organisations, to ensure that the systems are compatible across the different regions. However, despite the EU-US Task Force stressing the need for joint efforts, it seems that there is a risk of overlapping and competing standards emerging from the international bodies.

The C-ITS Platform is expected to take stock of the work undertaken by all the relevant bodies in the field of standardisation, in order to produce recommendations to ensure the

[14] Decentralised Congestion Control Mechanism for ITS operating in the 5,9 GHz range

alignment of the standards needed for the effective and holistic deployment of C-ITS in the EU.

Work Package 8: PUBLIC ACCEPTANCE

Despite the wide and mostly enthusiastic publicity given to driverless cars there seems to be significant fear and concern from citizens to that concept and there is a serious risk that if such attitudes to fully autonomous driving continue they will in turn contaminate the deployment of C-ITS services. Concerning the reasons for their concerns, people have mentioned the following reasons in some of the user surveys that have taken:

- I don't trust the driverless technology
- I can't see how liability would work in an accident
- I enjoy driving and don't want to be made to surrender that
- I don't like the thought of computers being in control of my safety
- I don't want my movements to be tracked
- I want to take my own driving decisions

There is a pressing need for a major communication and education exercise to explain not just the variety of technological possibilities, including autonomous vehicles, but also the potential personal benefits and contribution to wider societal issues.

There has been little publicity material setting out for a non-expert audience the full range of driving automation ranging from 100% driver-only mode via driver assistance, from both in-vehicle and C-ITS systems, to very high automation levels and ultimately the autonomous vehicle. Nothing has been done either to publicise the full range of cooperative support technologies, and the typical driver may well be unaware that connected systems are already widely used e.g. for information (dynamic route guidance) or that driver assistance services such as lane departure warning, intelligent cruise control etc have been on the market for some time.

The communication and education exercise needs to describe the different application areas (rural, urban, inter-urban, commercial freight, domestic & leisure etc.) and recognise the existence of many different user groups (Heavy Goods Vehicles and Public Service Vehicle owner/operator, young inexperienced drivers with expensive insurance, older driver at night, regular-route commuters, etc.) so that information and messages can be appropriately targeted and suitably directed.

The C-ITS Platform is expected to produce policy recommendations for the development of effective educational and communication programmes for improving the acceptance of Cooperative Systems by the general public and the different communities of beneficiaries.

Work Package 9: IMPLEMENTATION ISSUES

9.1 Driver distraction

Driver distraction has become an increasing concern amongst road safety experts, with the increasing range of technologies within vehicles creating the potential for drivers to have their attention taken away from the driving task. There is also the slightly special case of driver underload: lapses in concentration as a result of insufficient stimulus because of a reduced driving task.

C-ITS applications are part of a wide range of technologies already present in today's vehicles that could contribute both to reducing risk and to adding a source of distractions. Driver distraction is an issue that is broader than C-ITS and needs to be addressed in a holistic way. Although safety and collision warning systems will be designed to only notify a driver by exception, and should therefore not affect the general driving task the majority of the time, there are potential risks that must be understood by and addressed by designers. Furthermore, infotainment applications, as well as the use of portable nomadic devices in general, may tempt drivers to switch their attention from the road. C-ITS applications do add weight to the need to look closely at distraction issues.

There is a substantial work undertaken and on-going in the fields of Human Machine Interface (HMI) and Safe Applications (Safe Apps) carried out by several initiatives and groups both at European and international level with a strong involvement of relevant stakeholders.

The Platform is expected to take stock of these activities and provide recommendations, especially in relation to the eventual need to review and update the European Statement of Principle on HMI (ESoP)[15] and the need of further HMI international standards.

9.2 Unequipped road users

One of the major implementation challenges will be the coexistence of equipped and unequipped road users, mainly in the first years of the deployment of C-ITS. Many experts fear that the safety of unequipped users will be severely jeopardised and especially so in the case of vulnerable road users (VRU). The question of how to deal with VRU and other unequipped road users, especially in the transition phase, has to be properly addressed.

9.3 How to foster deployment

[15] Recommendation on safe and efficient in-vehicle information and communication systems: a European Statement of Principles on human machine interface" (OJ L19, 25.01.2000) reviewed on 2006 and 2008.

The benefits of C-ITS applications may be limited until there is a significant population of vehicles and roadside units fitted with the necessary technology. Under these circumstances there might be different avenues to be explored with a view to encouraging the early uptake of technology. Among these possibilities the following are considered of higher relevance depending on the main objectives driving the deployment of C-ITS.

9.3.1 The role of incentives

One of the areas to be discussed on the basis of the results of the cost benefit analysis of C-ITS is whether incentives should be offered to drivers, manufacturers or operators to encourage the take-off of Cooperative Systems.

These incentives could take many different forms, including for example, financial incentives, and could be put in place by different relevant public authorities, European, national, regional or local.

The C-ITS Platform is expected to take stock of the experiences undertaken in Field Operational Tests and other relevant initiatives, and to develop, on the basis of the cost benefit analysis, recommendations regarding the role of the public sector in using incentives for an early uptake of C-ITS.

9.3.2 The role of legislation

Some regions seem to be inclined to consider the possibility of making certain type of vehicle communication mandatory, driven by the objective of improving road safety. This is the case for DSRC in the US. In other regions, including Europe, the drivers behind the deployment of C-ITS include factors such as road safety, better use of the transport network and improved sustainability. Mandatory general deployment through legislation might not be the right path to follow.

The question on whether the uptake of C-ITS technology should be encouraged in some specific higher-risk vehicle types or populations might be considered. However, this could only be envisaged if supported by the cost/benefit analyses and the business cases.

The Platform is expected to assess and make recommendations to be supported by a large majority of stakeholders, on whether regulation should be envisaged and for what purpose to give a push for the deployment of C-ITS in Europe.

9.3.3 Should retrofitting be considered?

Retrofitting could be an additional way to speed-up the deployment of C-ITS through after-market fitment or the use of nomadic devices in existing vehicles. This would certainly contribute to accelerating the penetration of connected vehicles, but at the same time it would

also present important technical challenges in terms of ensuring interoperability and a secured functioning of the system, mainly in the case of retrofitting elements connected to the vehicle control systems, that did not invalidate manufacturers' warranties.

The C-ITS Platform should analyse the pros and cons of retrofitting and develop recommendations in case this should be a path to be favoured in the future.

9.3.4 Joint Procurement

One of the obstacles in the early deployment of any new technology, and in this case of C-ITS, is the high cost of equipment until the market has reached the minimum viable size for mass production. This aspect may have a particular relevance for roadside equipment devices, for which the possibility of establishing joint procurement actions across the EU could bring clear benefits and accelerate the deployment in the earlier stages.

The platform should carefully look at the possibilities offered by joint procurement and provide recommendations to the European Commission in this respect.

Work Package 10: INTERNATIONAL COOPERATION

In a world in which markets have global players and require global strategies, international cooperation is fundamental for the development of C-ITS. In this respect, besides the existing initiatives and cooperation at private stakeholder level there is a formally structured on-going cooperation among the governments of the EU and the US and Japan that should be continued and strengthened.

The existing agreements to develop coordinated research in the case of the US, and to share information on on-going research and development projects in the case of Japan, can preclude the development and adoption of redundant standards, provide significant cost savings, and support and accelerate the deployment and adoption of C-ITS.

In particular, the cooperation in the field of harmonisation of standards has to be highlighted, since it is key to enable industry players to potentially become global actors in the field of C-ITS.

Cooperation should continue among the three geographical regions along these lines, but could potentially be enlarged to cover other dimensions linked with the deployment of C-ITS, such as sharing experiences and knowledge regarding deployment and implementation issues, as well as user acceptance. This seems to be extremely valuable already at this stage.

Furthermore, although no formal cooperation agreements are in place, the informal exchange of experiences with other regions such as Australia, Canada, China or Korea exists and a formalisation could eventually be considered.

The Platform is expected to make recommendations regarding C-ITS deployment issues that would benefit from an enhanced cooperation with other partners,

Work Package 11: ROADMAP FOR DEPLOYMENT OF C-ITS

The objective of this work package is to integrate the findings and recommendations of the other building blocks of this work programme in order to produce policy recommendations and proposals for actions for the development of a roadmap for the deployment of C-ITS in the European Union.

This roadmap should set different scenarios indicating the timeframe and actions to be undertaken in each of them, as well as the actors who should be leading these actions. The aim is to conclude this exercise with a Communication from the European Commission, presenting the roadmap endorsed by a large majority of stakeholders with the outline for the years to come, identifying the actions necessary for each of the scenarios and indicating where industry, the public sector, or both working together, should be in the lead.

It is generally agreed that the implementation of C-ITS is an evolutionary process that will start with the less complex use cases benefiting different actors. The implementation of C-ITS needs an integrated multi-dimensional approach with appropriate bottom-up and top-down inputs. The technology is developing rapidly around the world, and C-ITS encompass the use of a large variety of technologies. Therefore, the roadmap resulting from this exercise has to be technology neutral and will flexible enough to adapt to technological, societal and policy changes – it needs to be a "rolling roadmap".

A very important question to be looked at refers to the "entry points" for the deployment of C-ITS. Should certain scenarios, or work with specific groups of users, be prioritised in order to accelerate the deployment?

Other regions, such as the US or Japan, are probably more ahead that the European Union regarding the development of deployment roadmaps for C-ITS. In this respect, it would be extremely valuable to take stock on what processes these regions have been through.

The deployment of ITS in the EU is not homogeneous. The priority given to C-ITS and the level of engagement with these technologies is expected to vary significantly among the Member States. This being said, there is a need to guarantee interoperability (notably through standardisation) as well as a continuity of service. Despite the fact that the menu of services offered may be different in different regions, a minimum common denominator throughout the network has to be ensured. In this respect, it is likely that technical specifications will have to be developed for applications in critical "hotspots" of the network, where implementation of C-ITS will probably start, such as the Trans-European Transport Network.

At the light of the scenarios and the options presented in the roadmap, financial mechanisms existing at European level, as those provided by "Horizon 2020" and the "Connecting Europe

Facility", both through grants and new financial instruments, are to be considered as instruments to stimulate an early deployment of Cooperative Systems.

The Platform is expected to develop policy recommendations and proposals for actions to be undertaken to support the different scenarios. These should be supported by a large majority of stakeholders in order to lead to the development of a roadmap for the deployment of C-ITS in the EU.