The SAFETRIP Project: improving road safety for passenger vehicles using 2-way satellite communications

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Abstract

Satellite communication can empower ITS to deploy safety critical services and services of the future, while reaching an unprecedented large number of road users in an eco-friendly and economical way. The SafeTRIP project embraces S-Band communication, creating a powerful and flexible open platform for services that road users need. In this paper, we firstly present an overview of the SafeTRIP project, the salient aspects of the platform and its communication infrastructure. Secondly, we emphasise on the focus the project has on user needs to shape services that would be supported by the SafeTRIP open platform. Finally, we describe the subset of services that have been selected on their relevance to road safety which will part of the trials and demonstrators within the project. We conclude by describing the road map and the project evolution in future.

1- Introduction

SafeTRIP is an Integrated Project (IP) of 20 partners from 7 European countries, representing partners with a wide range of research and business and interests and expertise, coordinated by the motorway company Sanef of France. The total research effort is about € 11.5 million, with funding of € 7.9 million by the European Commission (DG Research). SafeTRIP started in October 2009 and will last 3 years; its main objective is to improve the use of road transport infrastructures and to optimize the alert chain in case of incidents – this will be achieved through an integrated system from data collection to safety service provision.

SafeTRIP (1) will contribute to the EC objectives on road transport safety and road fatalities reduction, and at the same time offer a unique onboard communication system for information and entertainment.

SafeTRIP builds on a new satellite technology: S-band communication via the W2A satellite. W2A, which was launched by Eutelsat in April 2009, is specially designed for providing DVB-SH (2) broadcasting and opens new perspectives for European telecommunications. The S-band transmitter is optimized for multimedia content delivery and 2-way communications for on-board vehicles units, and is interoperable with 3G systems. This new satellite technology gives the opportunity to progress beyond the state of art allowing 2-way communications via small omni-directional antennas on the mobile units. Its advantages include full coverage across Europe, multicast data transmission, quick and easy deployment, and energy efficiency, since the satellite is powered by solar panels.

In the SafeTRIP project, the consortium chose to develop the full potential of this platform through extensive user requirements and technical research, experimentation and evaluation in field trials. To produce the best system, and to ensure that end users will benefit of this integrated system once deployed, SafeTRIP will develop and trial different applications in various contexts, evaluate benefits and opportunities for a range of stakeholders: individual travellers, transport businesses, emergency services, local and national government. The evaluation will include:

- Safety improvement assessment,
- Contribution to environment protection,
- Costs / benefits for the individual users,
- Market analysis for service providers and for telecom operators (satellite, terrestrial, cellular).

The main users' target of SafeTRIP applications are the drivers and passengers of cars and coaches.

The approach of this project is to demonstrate the technical feasibility, the business cases and to experiment a subset of applications using three road-based scenarios supported by on-field experimentations. Then, according to the project outcomes, we will identify other remaining obstacles - technical, legal, organisational, economic - for large-scale deployments. Our proposed business model is to allow any third party developers to implement their services using this unique, open system. The motor and telecom industry in general will be able to benefit from vehicles “always connected“.

2- SafeTRIP Overview

Communication Infrastructure

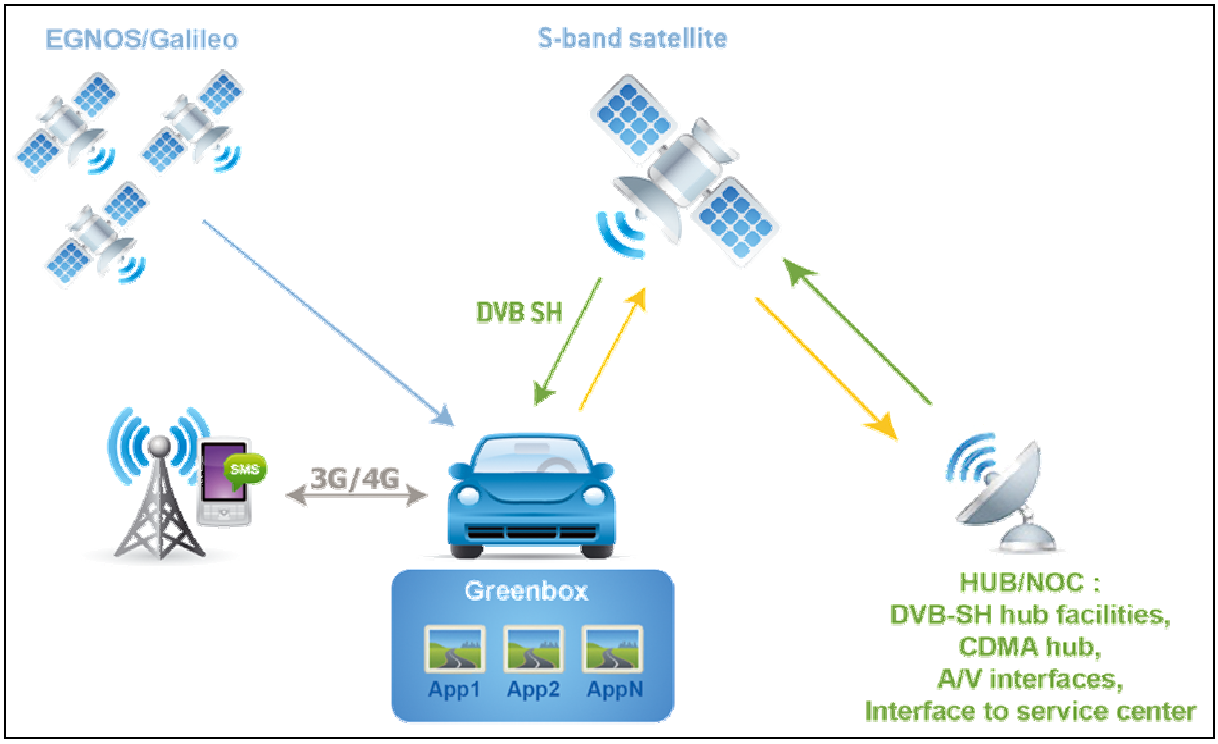

Figure 1 - SafeTRIP communication architecture

Thanks to the DVB-SH standard (3), SafeTRIP will use both satellite technology and complementary terrestrial networks. This combination has a number of unique features that makes it the best suited telecommunication technology for transport systems with intrinsic safety and security characteristics. Today, e-call systems started to improve the safety of European citizen as well as their comfort. But SafeTRIP will be the next step in that direction by ensuring the complete interoperability between spatial and terrestrial networks.

This feature has significant advantages such as:

- Global coverage: with a single geostationary satellite it is possible to provide service on wide areas, such as entire countries or continents. The global coverage is fundamental to achieve truly pan-European services.
- Immediate Full Coverage: while a terrestrial system can take years to be deployed over a significant fraction of the territory, and usually it stops for economic reasons to about 80% of surface, a satellite can provide full coverage of an entire country. Combined with a complementary ground network, it ensures that vehicles are connected / rescued everywhere in Europe. Additionally, it means that a larger users' base can immediately access the service, ensuring a better market penetration.
- Energy-efficient operation: the satellite receives its operating power from the sun, through solar panels. To provide the same level of service over a territory, any terrestrial technology would require significant construction works that would increase the environmental pollution and a large amount of electrical power to feed all transmitters.

The Green Box

The GreenBox is a low cost on-board unit that can be fitted in any car or bus. Both manufacturers Masternaut and Quantum will develop a family of receivers that will address various user needs, from car driver to bus passenger. Connectivity of the GreenBox receivers is a highly important feature, as it will include satellite communication and positioning, terrestrial communications via S-band, 3G or WiFi networks, etc.

An Open Platform

The SafeTRIP platform is being designed from ground-up to be an open platform. The GreenBox will offer an open API that will allow third party applications to have access to functionalities of the GreenBox. In addition, a set of enabling services including VoIP and GNSS localization for example will be setup to provide a backbone for applications. By giving access to the communication infrastructure as well as enabling services, application developers can create new applications and services for the SafeTRIP platform. For instance, it would be possible to develop location based services that would run on the platform and use the geographical location of the vehicle to retrieve relevant information from the communication link. We believe this is key to the development of innovative services in future.

3- User Needs

The initial user requirements are based on the needs put forward by partners within the consortium who will also be users of the SafeTRIP platform, henceforth referred to as

partner-users. They are Eurolines, Abertis, IMA and Sanef: Eurolines provides low-cost coach travel across Europe, Abertis and Sanef are road operators in Spain and France respectively; and IMA, an assistance company, develops and offers road safety services to individual drivers through its parent insurance companies including MACIF and MAIF. Additionally, the experiences and unmet needs of individuals (vehicle drivers and passengers) and organisations outside the SafeTRIP consortium have been collected – that we refer to as stakeholder needs. Both the partner-user and stakeholder needs have been analysed, and form the basis of an initial set of requirements in terms of services to be supported by the SafeTRIP platform.

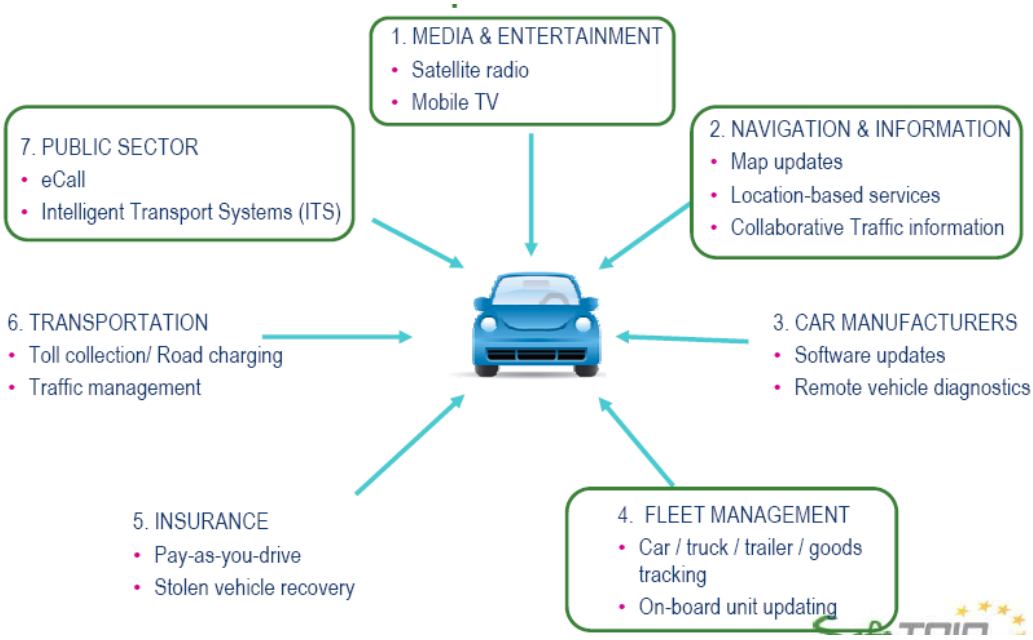

Figure 2 - SafeTRIP services for the demonstration

Partner-User Needs

Several site visits were undertaken at each partner sites during the first and second quarters of the project. The needs of the partners have been established through discussions, observations, presentations and meetings. These have been classified as Core Needs, Should-Have Needs and Desirable Needs reflecting the importance of the needs from the partner's perspective.

The following is a list of most common and important needs expressed by partners' users:

1. To reliably retrieve the geographical location of the vehicle (for providing assistance or tracking vehicles (e.g. hazardous goods vehicle, coaches))
2. To have access to information about the vehicle including passenger information, cargo carried (if any), vehicle specifics (dimensions, type) and car sensors
3. To have a reliable communication link with the vehicle for voice and data transfer.

Stakeholder Needs

The needs of individuals were captured through interviews and discussions. The individuals interviewed included users of existing satellite navigation solutions, users of VIRGIL and SYGEO which are products from IMA offering road assistance, emergency services, vehicle surveillance and navigation and users who travelled regularly across Europe.

The following is a list of most common and important needs expressed by individuals:

1. To have an always-available communication link for requesting assistance for any kind of emergency (including medical, road assistance, accident) and subsequent communication
2. To receive relevant, useful and timely traffic information in the vehicle
3. To have a navigation application that plans routes to account for
    a. Current traffic conditions
    b. Adverse weather and road conditions
    c. Costs (toll charges)
    d. Services available along the route.

We have also started to capture the needs of organizations and businesses outside the SafeTRIP consortium. As a first step, we have looked into the East/West corridor issue at the border crossings in Poland and have captured the needs from transport operators that would help alleviate the exceedingly long waiting times and congestion at those crossings. At this stage, their needs largely overlap with that of the partner-users described in the previous section.

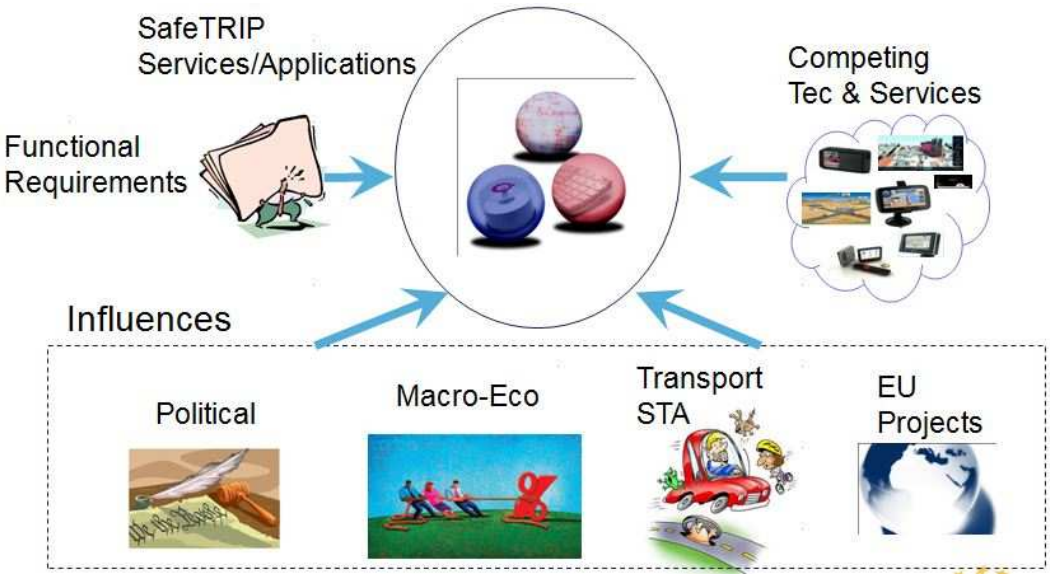

Figure 3 - Influences that shape the SafeTRIP platform

The SafeTRIP platform is subject to influences from existing competing services and technologies, political and macro-economic influences, directives from the European

commission, research work in the field of transport as well as ongoing EU projects in ITS. An analysis of these influences has been carried out and recommendations have been formulated to guide the design of the platform.

Services

Based on initial findings, a set of safety and comfort services will be developed and experimented, including:

- Emergency call service – eCall (safety of persons);
- Vehicle surveillance: localisation of stolen vehicles (safety of goods);
- Road safety alerts – hazard and incident warning;
- Buses travel monitoring: vehicle route tracking, to prevent using any unauthorised route, prevent excessive speed, alert delays;
- Bus passengers management: counting and indentifying passengers on board at each embarkation/disembarkation,
- Access to Streaming media and TV channels;
- Connect mobile devices for internet access;
- Remote assistance and diagnostics through video uplink;
- Monitoring hazardous and dangerous goods vehicle;
- Robust hybrid communication channel with failsafe (combination of satellite and terrestrial channels);
- Monitor driver behaviour (professional drivers and individuals);
- Pay as you drive – services for fleets: an environment allowing periodic feedback on vehicle use and behaviour (position, mileage, type of road, schedules of circulation, CO2 emissions);
- Trip optimisation: mapping vehicle location and status, delivery optimisations.

Requirements

The functional requirements for the platform were determined based on the importance of the services required by the partner-users and stakeholders. This was determined by considering the nature of problem they address and their road safety implications and listed using the MoSCoW methodology for classification.

Based on initial study, it is clear that the SafeTRIP platform will need to provide the following at the very least in order to support the services that would satisfy the partner-user and the stakeholder needs.

1. Offer a communication channel that uses the most effective communication link available when needed (a combination of satellite, terrestrial and V2V communication technologies),

2. Provide reliable information from the vehicle (including and not limited to its geographical position, content – passenger and cargo, state (detection of accident), sensor information),
3. Provide media and information in the vehicle (including and not limited to traffic information, general information and entertainment media such as TV and radio).

The user needs capture will last for the entire duration of the project with the aim to produce a final set of user requirements for the SafeTRIP platform of the future. The project will run workshops with representatives from different business sectors and public sector organisations.

4- Competing Technology and Services

A review of competing technologies and services has been carried out in order to determine their positioning with regards to SafeTRIP. Technologies such as DSRC, IR, WiFi, Wave, UMTS-HSDPA were seen as complementary technologies that could be supported by the SafeTRIP platform. Potential collaboration avenues were identified with existing services. For instance, the Coyote system was perceived as a potential customer for SafeTRIP. Many of the services reviewed suffered from limitations arising from the communication technologies that were being used – making them either costly or inaccessible due to poor coverage in less built-up areas with minimal terrestrial communication infrastructure.

The analysis therefore confirmed the need to have vehicle connectivity over larger territory. The open SafeTRIP platform would provide an opportunity for those services to overcome the limitations by offering a resilient communication framework which relies on a myriad of technologies- including the S-Band. The analysis also provides relevant pricing information that will shape the business models being considered for the deployment of SafeTRIP. It is however clear that there is need for:

- Provision of a pan European coverage without roaming charges
- Support of the widely popular TMC protocol
- Car-to-car communication technical compatibility.

5- Demonstrator

The aim of these trials is to demonstrate that the Greenbox is able to support existing services as well as new services developed within SafeTRIP.

Low price on-board-units (the Greenbox receiver) will be installed in vehicles to provide personalised safety and comfort services during a period of 6 months. Customer-oriented applications targeting individual car drivers, professional coach drivers, passengers and road

operators will be tested in the field, by French and Spanish road operators (Sanef, Abertis), coaches' operator (Eurolines) and car drivers (through insurance and assistance companies IMA/MAIF/MACIF). Applications and services for coaches will be tested on the Paris-Brussels-Amsterdam and Paris/London corridors on a fleet of buses provided by the operator Eurolines.

It is important to note that, in the context of this demonstration; most of the proposed applications will be interfaced with existing commercial service centres and, as a consequence, will be fully interoperable with existing On-board units. For example, the emergency call application demonstrated during the field trials will be interfaced with an operational call centre of IMA meaning that in case of distress, the call from a SafeTRIP end user will be handled in the same way as customers of existing emergency call services.

The services that will be demonstrated during the field trials are divided into 3 categories:

- Road safety services
- Applications for coaches
- Entertainment applications.

Road safety applications

Emergency call

The main road safety application that will be tested during the field trials is the emergency call via satellite. This service will support the following features:

- Emergency call initiated either manually or through automatic detection of an incident thanks to an interface between the Greenbox and the vehicle
- Ability to send the vehicle geographical position to the call-centre using the satellite messaging service
- Ability to set up a voice call between the vehicle and the call centre using the satellite link.

The Emergency Call application implemented by SafeTRIP will be able to choose the best communication link (either terrestrial or satellite) based on factors such as availability, quality of service and cost. Due to the use of Satellite communication, SafeTRIP is able to provide a full European coverage coupled with the best economic efficiency for emergency calls.

As an extension to this application, SafeTRIP will explore the possibility to establish a video communication link between the vehicle and the service platform, in order to view the state of vehicle occupants, in particular if they are unable to talk. This would also improve accessibility as it would be beneficial for the disabled who are hard of hearing or deaf to communicate using sign language.

Tracking of stolen vehicles

SafeTRIP will support the service which will allow stolen vehicles to be tracked in case of theft. Typically the driver has to undergo an authentication before starting the engine – normally by entering a pin or using a magnetic tag. If the authentication fails, and the vehicle is found to be on the move, the vehicle is considered stolen. The service centre will first contact the vehicle owner to check whether he is aware of the vehicle movement to avoid false alarms. Once it is established that the vehicle is stolen, the service centre will track the movement of the vehicle through the Greenbox and work in collaboration with the police to recover the vehicle.

This service can also be used to provide the last GPS positions, to assist in finding the vehicle in cases where the communication link was disrupted or onboard unit was damaged as a result of an incident, theft or simply a break-down in a remote area.

Road safety alerts service

Through the road safety service, the driver will be having access to traffic information and be alerted about potentially dangerous areas. This is expected to encourage the driver to adopt a more cautious driving behaviour. For instance, the driver may be alerted about an upcoming accident prone area. The safety alerts will be provided by an existing service provider who will use the SafeTRIP platform.

This service will offer the following features:

- Up-to-date information about dangerous zones, e.g. accident prone areas
- Notification of the traffic status in quasi real time
- Notification of mandatory speed limits.
- Notification to maintain driver alertness

For optimal usage of the satellite link and due to the nature of this service, warnings can be broadcasted to vehicles in a region, instead of using separate unicast links. This would also have the benefit of reduced communication costs.

Collaborative road alerts

This service is similar to the road alert service described above. However the alerts are generated from floating car data and from the knowledge base created by the individual drivers. Each Greenbox will transmit data related to the vehicle status via the satellite messaging service. A service centre will collect and process these floating car data and generate relevant alerts using proven hazard detection algorithms. The alerts will be broadcasted using the satellite link.

This application - specifically developed for the SafeTRIP demonstration - will offer the following features:

- Automatic collection of vehicle data (speed, temperature…)
- Possibility to manually point out a potential danger
- Processing of floating car data in order to generate security alerts
- Displays of the security alerts.

Applications for coaches

Real time tracking service

This service allows the coach operator to track its fleet of coaches. It will provide the ability to locate all the vehicles and to monitor specific vehicles.

This service will offer the following features:

- Automatic collection of vehicle data (speed, temperature,…) and transmission of the data using satellite messaging service
- Web based visualisation interface for the operators to track the position and status of coaches as well as review the journey history of each coach
- Monitoring of unusual behaviour of the coaches: excessive speed, deviation from planned route, wrong direction…

Passenger tracking

This service will allow the coach operator to monitor the flow of passengers onboard its coaches. The bar code printed on each travel ticket is scanned when a passenger boards the coach. In case of a road incident, the head office will be able to know exactly who is onboard of the coach and therefore relay pertinent information to the rescue services, supporting effective and timely extraction of passengers. This will allow the operator to provide information to rescue services about the persons onboard and inform the families of the passengers.

This application will offer the following features:

- Bar code scanner linked to the Greenbox
- Web based visualisation interface to see who is on the coach in real time

This service will be developed specifically for the SafeTRIP demonstration.

Large scale fleet management

This service will enable the management of large fleet of vehicle all over Europe. It will support both the broadcast of messages to the entire fleet of vehicle and the sending of messages to a specific vehicle. It will also allow the sending of optimised routes to the coach drivers using up to date traffic information.

This application will offer the following features:

- Broadcast of information to the whole fleet
- Broadcast of information to vehicles depending on their geographical location
- Sending of messages to a specific vehicle
- Dispatch navigation instruction to the vehicles in order to modify their itinerary.

Applications for Hazardous Goods Vehicle (HGV)

HGV tracking

This service will allow road operators and other authorities to track HGV as they enter and leave different segments of the motorway. Due to the nature of the goods that is transported by HGVs, their involvement in a road incident has serious implications for road operators. This would allow road operators to be better prepared in case of incidents. In addition, HGVs are required to have permits to cross motorways, and in practice they do not always abide to this requirement. Road operators could alert the authorities when there is a breach.

HGV parking assistance

This service will provide assistance to HGVs to find the nearest and most appropriate parking location. Inappropriate parking of HGVs, for example on the hard shoulder, is a source of danger for road users. The service will access information about the vehicle dimensions and cargo in order to determine the parking requirements.

Patrol vehicles monitoring

This service will allow road operators to monitor the status (vehicle position and activity) of the patrol vehicles in order to provide fast and effective response to road incidents. In addition, the patrol vehicles can act as ‘sensors on the move’ by providing timely information about the road through sensors, such as video cameras, when attending incidents or when patrolling areas of the road network that have low static sensor density.

Entertainment services

Though not the primary objective of SafeTRIP, the Greenbox offers the opportunity to have innovative and new entertainment services in the vehicle. There are difficulties associated with the installation of on-board units in the vehicle post-assembly such as extra cost, interference with vehicle system and aesthetics issues. Market analysis of existing services has shown that the appeal of safety services can be greatly increased by packaging them with entertainment services – thus overcoming the difficulties. Entertainment services would therefore help in achieving a better market penetration and impact.

Live TV/Radio

This service will allow the reception of digital radio and TV channels broadcast over W2A

satellite in the vehicle.

Datacast services

This service will allow the broadcast of various multimedia contents from the service centre to the vehicles. This content will be accessible offline by the vehicle passengers.

6- Conclusion

In this paper, we presented an overview of the SafeTRIP platform, the user needs gathered so far that have shaped the services to be supported, and finally the list of services that will be demonstrated within the project. A number of collaborations and interactions have been planned with ITS organisations, the industry and networks of excellence such as the NEARCTIS to tap into the vast knowledge base in order to define a platform that will be future proof and will meet the real needs of all stakeholders in the transport sector. In conclusion, the SafeTRIP platform opens up the opportunity for innovative and robust services that will not only contribute to road safety but also many other aspects of ITS. The communication infrastructure will allow services running on the SafeTRIP open platform to have access to a large number of options for connectivity – satellite, terrestrial and car-to-car communication. The Greenbox - the hardware of the platform - will provide the appropriate middleware to allow services running in the vehicle to have access to sensor information in the vehicle as well as infotainment from external sources.

Acknowledgement

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