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Upcoming innovations of devices and functions imbedded in services

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF ABBREVIATIONS

ABBREVIATION	DESCRIPTION
ABS	Antilock Braking System
CAGR	Compound Annual Growth Rate
CAN	Controller Area Network
CCC	China Compulsory Certificate
CE	Conformité Européenne
CEO	Chief Executive Officer
ECU	engine control unit
ESP	Electronic Stability Programme
FCC	Federal Communications Commission
FCD	Floating Car Data
GPRS	General packet radio service
GPS	Global Positioning System
GSM	Global System for Mobile communications
HMI	Human Machine Interface
IOT	Internet of Things
ISO	International Organization for Standardization
LCD	Liquid Crystal Display
LDW	Lane Departure Warning
LED	Light Emitting Diode

ABBREVIATION	DESCRIPTION
OCS	the Occupant Classification System
OS	Operative System
PC	Personal Computer
PDA	Personal Digital Assistant
PND	Portable Navigation Device
POI	Point of Interest
RAM	Random Access Memory
RDS-TMC	Radio Data System - Traffic Message Channel
ROHS	Restriction of the Use of Certain Hazardous Substances
RUC	Road User Charging
SBC	single board computer
SIM	Subscriber Identity Module
SMS	Short Message Service
SUV	Sport Utility Vehicle
TMC	Traffic Message Channel
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial Bus
VMS	variable messaging systems
WiFi	Wireless Fidelity
WSN	Wireless Sensor Network

ABBREVIATION	DESCRIPTION
WWAN	Wireless Wide-Area Networks

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EXECUTIVE SUMMARY

The Deliverable D2.6.2 Upcoming innovations of device and functions imbedded in services is the second deliverable of WP2.6 Technology and Service Observatory. This work package analyses the available technology and infrastructure equipment in the market in order to have a proper insight into what constitutes the potential and limitations of new ICT solutions.

The objective of this document is to provide the project with relevant and up to date information about the devices and functions available in the market and that can be potentially used in the different FOTs of the project.

More concretely this document is focused on the analysis of the infrastructure equipment and on-board devices and the functions imbedded in the services.

Through the different sections and subsections of the deliverable, the different elements and functions are analysed in terms of their status on the market. Terms as the maturity, availability or price (among others) of the devices or functions have been analysed and compiled in the present document.

1. INTRODUCTION

TeleFOT is a Large Scale Collaborative Project under the Seventh Framework Programme, co-funded by the European Commission DG Information Society and Media within the strategic objective "ICT for Cooperative Systems".

Officially started on June 1st 2008, TeleFOT aims to test the impacts of driver support functions on the driving task with large fleets of test drivers in real-life driving conditions.

In particular, TeleFOT assesses via Field operational Tests the impacts of functions provided by aftermarket and nomadic devices, including future interactive traffic services that will become part of driving environment systems within the next five years.

Field Operational Tests developed in TeleFOT aim at a comprehensive assessment of the efficiency, quality, robustness and user acceptance of in-vehicle systems, such as ICT, for smarter, safer and cleaner driving.

The main objective of this Deliverable is to provide an overview of the situation of the new infrastructure equipment and on-board devices available in the market, as well as the status of the available functions embedded in the systems.

This deliverable is written as part of the outcomes of the "observatory study" performed in WP 2.6 the main objective of this technology observatory is to have a proper insight into what constitutes the potential and limitations of new ICT solutions, infrastructure equipment, on board devices and innovative functions and services that TeleFOT can find in the market.

More concretely D2.6.2 will compile the work done in tasks T2.6.2 and 2.6.3. These tasks are focussed on the Infrastructure equipment and on board devices study and the analysis of the functions imbedded -in the services, respectively. This document will therefore try to summarize the current situation of both the infrastructure and on board equipment and the functionalities available in the market, by presenting, for each element, their current maturity, availability, price, etc.

According to the work done in WP2.6 and compiled in the actual document, deliverable D2.6.2 can be considered a report of the achievements of studies carried out in T2.6.2 and T2.6.3. As such, it can be very useful as a technology guide for those test sites, projects or anyone planning to set up an FOT. The information contained in this document does not go into a deep analysis of the devices and functions presented. Despite of that, it provides a clear overview of the situation of the new infrastructure equipment and on-board devices available in the market, as well as the status of the

available functions embedded in the systems. This kind of information is always necessary for the first steps of a decision making process, giving the reader the main information to decide which devices and functions are more suitable for their purposes, so that they can go into more detail when needed.

This document has been structured in three different sections (apart from the introduction). The section 2 will present the outcomes of the work performed in task T2.6.2 Infrastructure equipment and on-board devices.

On the other hand, the section 3 is compiling the work performed in task T2.6.3 Functions embedded in services. While the fourth sections compiles a brief summary of the foreseen upcoming innovations regarding both the devices and functions studied in WP2.6 and presented in this document.

2. INFRASTRUCTURE EQUIPMENT AND ON-BOARD DEVICES

In the last few years, a number of innovations have been introduced in the area of Infrastructure equipment and on-board devices. These devices and technologies have been studied in order to choose the most appropriate ones for the test sites.

The following list shows all the different infrastructure elements and on board equipment studied in task T2.6.2:

- **Vehicle sensors**: they are installed in the vehicle and used to assess both vehicle and environment conditions, for example to detect adjacent vehicles/pedestrians or dangerous situations.
- **Driver sensors**: they are installed in the vehicle and used to detect driver abnormal behaviour.
- **HMIs**: in general Multimodal Interfaces (Speech technologies, gestural interfaces, touch sensitive…) are used by the driver to interact with the vehicle and on-board devices, such as the PNDs used in TeleFOT.
- **PDAs**: they usually provide the same functionalities as Smartphones or PNDs
- **Smart phones**: in addition to telecommunication features they offer a wide range of functions, including the ones studied in TeleFOT.
- **Personal Nomadic Devices**: they provide the functions studied in TeleFOT and represent the second area of focus in the TeleFOT project.
- **Integrated computers**: otherwise known as Car-PCs they usually provide the same functionalities as normal PCs but can operate in more harsh conditions
- **Safety and security devices**
- **Infrastructure equipment**: they are installed in the network infrastructure and include traffic management, monitoring and visualisation systems, such as cameras, radar, traffic lights, variable messaging systems (VMS).

For each element a series of issues have been studied and reported in this deliverable (maturity, availability, price, use in TeleFOT test sites, processing and memory capacity, power consumption, environment certification)

2.1. Vehicle sensors.

Today's vehicles are equipped with a multitude of sensors and information sources which contain an enormous amount of knowledge about the vehicle's ego-state (position,

speed, course or hazard condition, etc.) and the local environment (road surface condition, lane occupancy, etc.). Information sources can be clustered in the following: Vehicle Dynamics Management, Body Management, Occupant Safety Systems, Environmental Perception, Navigation, Static Vehicle Description. Vehicle sensors providing this data are controlled by the vehicle ECUs such as Gearbox, ABS, ESP, Brake, restraint systems...

2.1.1. Maturity

Technically these sensors are mature and some of them have been on the market for a long time (e.g. speed sensors on wheels for ABS)

2.1.2. Availability

These sensors are available on nearly all vehicle segments.

2.1.3. Price

Depending on the type of sensors, the price can be anywhere from tenths to thousands of Euros.

2.1.4. Use in TeleFOT test sites

Sensors of this type, for example to retrieve speed and position are used in nearly all test sites.

2.1.5. Processing and memory capacity

The processing and memory capacity is usually associated to the ECUs piloting the system, for example the airbag ECU.

2.1.6. Power consumption

These sensors can run with batteries In the example of the tyre monitoring pressure system, to cope with extended lifetime of more than 7-10 years, the current consumption is in the order of hundreds mA.

2.1.7. Environment certification

n/a

2.2. Driver sensors.

New vehicles are equipped with several sensors that improve the driver security and safety. These sensors do not work isolated, but are part of a system that monitors the

driver behaviour or control some passive safety elements in the car with some sort of intelligence. Some good examples for these systems are the Occupant Classification System (OCS) or the driver drowsiness monitoring.

The OCS is a system of sensors that detects if someone is sitting in the front passenger seat and classifies the occupant size category in order to distinguish whether the passenger is an adult or child-size person and switch on or off the front passenger airbag.

The driver drowsiness monitoring is a system that uses multi-sensor data acquisition to monitor the driver and predict the drowsiness level of the driver to detect whether he is getting too tired to continue driving.

2.2.1. Maturity

The sensor technology is mature but the systems that allow monitoring the driver behaviour are quite new and still under development.

2.2.2. Availability

Some systems are already available.

2.2.3. Price

From tenths to thousands of €

2.2.4. Use in TeleFOT test sites

Yes, whenever they are installed in the driver's car

2.2.5. Processing and memory capacity

The processing and memory capacity is usually resident in the ECU or system installed.

2.2.6. Power consumption

This characteristic belongs to the system itself.

2.2.7. Environment certification

Sensors are usually certified CE, ROHS, FCC, CCC.

2.3. HMIs.

Human-Machine Interfaces are the means through which a person and a machine can communicate between each other.

This communication must be established in two directions: the communication from the machine to the person and the communication from the person to the device.

Rigorously, a multimodal interface is an interface where the information is transmitted using two or more means (e.g. visual, auditory, haptic). These means can be used depending on the context of use (e.g. auditory interface is used when the visual one can provoke some distractions that can end up being dangerous). A great example on this is the PND. These devices can use different modalities (visual and auditory) to show or receive the information. The modality can be chosen by the user or can be automatically selected in order to preserve safety (e.g. above a speed limit, the map is not shown and only icons or voice instructions are given).

However, if we think in 'information' as a whole, when the information given by one modality is complemented by another modality, we can talk about multimodality as well (e.g. visual information is supported by a haptic feedback).

2.3.1. Maturity

Multimodality HMI are a well developed reality nowadays. At the present time, development is focused on multimodality HMI in several devices simultaneously.

2.3.2. Availability

Multimodality HMI are present in almost all the nomadic devices.

2.3.3. Price

Variable, depending on the device.

2.3.4. Use in TeleFOT test sites

Yes, for example in navigators devices

2.3.5. Processing and memory capacity

n/a

2.3.6. Power consumption

This characteristic belongs to the device itself.

2.3.7. Environment certification

n/a

2.4. PDAs

A personal digital assistant (PDA) is a handheld computer, also known as a palmtop computer.

The first PDA is considered to be the CASIO PF-3000 released in May 1983. GO Corp. was also pioneering in the field. The term was first used on January 7, 1992 by Apple Computer CEO John Sculley at the Consumer Electronics Show in Las Vegas, Nevada, referring to the Apple Newton. In 1996 Nokia introduced the first mobile phone with full PDA functionality, the 9000 Communicator, which has since grown to become the world's best-selling PDA and which spawned over the category of smart phones.

Newer PDAs also have both colour screens and audio capabilities, enabling them to be used as mobile phones, (smartphones), web browsers, or portable media players. A PDA has an electronic visual display, enabling it to include a web browser, but some newer models also have audio capabilities, enabling them to be used as mobile phones or portable media players. Many PDAs can access the internet, intranets or extranets via Wi-Fi, or Wireless Wide-Area Networks (WWANs). Many PDAs employ touch screen technology. PDAs integrating also phone capabilities, called smartphones, are now replacing PDAs (source: Wikipedia).

From a software point of view PDAs used proprietary OS, with limited speed and high resources required. This is one of the main reasons of their market abandon, in favour of smart phones and tablets.

2.4.1. Maturity

Now PDAs have almost entirely been replaced by Smartphones.

2.4.2. Availability

Only at the internet or in specialised shops.

2.4.3. Price

Depend on producer and model: between 150€ and 650€ (without navigation software).

2.4.4. Use in TeleFOT test sites

Since now PDAs are mainly replaced by smartphones, PDAs are not used in any TeleFOT test sites.

2.4.5. Processing and memory capacity

Processing speed is between 266MHz and 624MHz; memory capacity (RAM) is between 8MB and 128MB. To give a comparison, Apple iPod Touch, considered the evolution of PDAs, has 1GHz processor (underclocked to 800 MHz) and 256MB RAM memory.

2.4.6. Power consumption

The battery duration is between 8h and 140h (in standby mode).

2.4.7. Environment certification

ISO 9001:2008

CE certification

Electromagnetic compatibility (Bluetooth)

2.5. Smart phones

A smart phone is a mobile phone offering advanced capabilities beyond a typical mobile phone, often with PC-like functionality. There is no industry standard definition of a Smartphone. For some, a Smartphone is a phone that runs complete operating system software providing a standardized interface and platform for application developers. For others, a Smartphone is simply a phone with advanced features (source: Wikipedia).

2.5.1. Maturity

The market of Smartphones is completely mature.

2.5.2. Availability

Smartphones are widely available, in the Internet or in special shops.

2.5.3. Price

The price depends on the Producer and Model, in range between 150€ till 680€. For the use in TeleFOT, it is to be noted that not all smartphones have navigation software on board!

2.5.4. Use in TeleFOT test sites

Smartphones are being used as navigation devices, for example in the Italian L-FOT.

2.5.5. Processing and memory capacity

Processors and operating systems (for example "Windows Mobile 6.1 Professional") are often available in a similar and competitive way with respect to PCs. Memory capacity between 64MB and 16GB are widely available.

2.5.6. Power consumption

Autonomy of these devices can range between 120h and 450h (in stand-by mode).

2.5.7. Environment certification

ISO9001; ISO14001:2005

2.6. PNDs

A PND is a portable electronic product which combines a positioning capability (such as GPS) and navigation functions. Generally they have LCD display smaller than 6” (only 7% are greater) using LED backlight with touchscreen control. Actually 2D graphics for navigation is predominant, but from 2013 3D will take the majority of the market of PNDs. Moreover the great part of PNDs are also able to provide some infomobility data, like traffic condition (23,5%), received via TMC, and the possibility to play back video and audio files. 15% of actual PNDs have also Text-To-Speech and voice recognition for Human Machine Interface.

The trend is to have PND more and more connected every day. Both connectivity with other onboard devices and with outside infrastructure are increasingly available on PND. Internal connectivity allows using steering wheel buttons and audio system, while telematics is the enabling technology to make available many services on board. Actually 5% of the PNDs have a cellular connection capability, enabling many services, like weather information, map and POI update, news, internet browser, SMS and, in general, location based services.

Most of the PNDs available on market are consumer devices, with windscreen sucker support and cable for 12V power supply through vehicle’s cigar lighter, while only few of them have higher degree of interconnection. They are safe and easy to use systems thanks to the high degree of on board integration, from both an electrical/mechanical and connectivity standpoint. The adoption of this architecture results in considerable possibilities: data coming from the vehicle can be used by the PND to improve navigation, voice messages can be reproduced by the on board audio system and the destination can be entered by means of the steering wheel pushbuttons or voice

commands. All this contributes to guarantee higher standard in terms of both comfort and safety.

Market leaders are TomTom, Garmin, Becker. The Magneti Marelli has developed its own PND, the *Blue&Me* Map device, a stand-alone device intended to be used in cars, then has developed *Blue&Me TomTom* [3], in collaboration with TomTom and Fiat.

2.6.1. Maturity

PNDs are a substantial but declining market; average selling prices have fallen to about $120 and will continue to decline. PND companies continue to increasingly build sales in the non-PND business including dedicated solutions the automotive market.

2.6.2. Availability

The table below reports the global expected growth of the market between 2007 and 2017. To be noted that the CAGR over the period is expected to be null, showing an overall stagnation of the sales and a negative trend after 2014.

Table 1: Global expected growth of PNDs 2007-2017.

Production (000's)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR (09-17)
Global	32.000	43.101	39.708	40.729	41.991	43.842	44.372	44.088	43.138	41.880	39.750	0,0%
Growth		34,69%	-7,87%	2,57%	3,10%	4,41%	1,21%	-0,64%	-2,15%	-2,91%	-5,09%	
Europe	13.551	18.181	15.730	15.269	14.776	14.343	13.923	13.563	13.212	12.606	11.636	-3,7%
Growth		34,17%	-13,48%	-2,93%	-3,23%	-2,93%	-2,93%	-2,59%	-2,59%	-4,59%	-7,69%	
Average selling price (Global, US $)	275,0	225,5	179,3	147,0	120,5	98,8	83,3	74,7	66,9	60,6	57,3	-13,3%
Growth		-18,0%	-20,5%	-18,0%	-18,0%	-18,0%	-15,7%	-10,4%	-10,4%	-9,4%	-5,4%	

Source: Strategy analytics Q1 2011

PNDs are facing a major problem with availability as retailers are turning away from PNDs and instead using store space to expand their coverage of tablets and smartphones. This is shown with a decrease in the production in Europe from 2009 and globally from 2014.

2.6.3. Price

Price range is roughly between 79€ (entry level) up to 500€. They are also available with additional monthly package (e.g. Live Service package at €9.95/month). Average selling price is rapidly falling, but in the future with a smaller decrease (see also previous table).

2.6.4. Use in TeleFOT test sites

PND will be used on TeleFOT sites to assess them over the five areas of safety, mobility, efficiency, environmental and user uptake aspects. PNDs are used in Italian DFOT, UK LFOT, German DFOT and Spanish LFOT.

2.6.5. Processing and memory capacity

Processor speeds are from 200 MHz to 500 MHz. From 1 to 4 GB of internal memory (flash), generally (in 98.5 % of devices) with the possibility to add a SD memory card.

2.6.6. Power consumption

Battery lasts from 2 to 4 hours in working mode.

2.6.7. Environment certification

ISO 9001:2008

CE certification

Electromagnetic compatibility (Bluetooth)

Directive 2006/28/CE

Automotive compliance (for integrated devices), based on each single carmaker requirements in term of safety and interoperability, for example crash proof test.

2.7. Integrated computers (Car-PC).

CarPCs are small factor PCs designed to be integrated and installed in a vehicle. They are typically based in an industrial embedded SBC (single board computer) with an automotive power supply, integrated graphics, sound, USB and Ethernet connectivity and a hard disk (or compact flash memory) with a rugged, compact aluminium chassis. This equipment is complemented with an HMI device, typically a 7" touchscreen.

2.7.1. Maturity

CarPCs are mature devices.

2.7.2. Availability

There are many distributors in the market (Advantech [4], VIA Technologies, Axiomtek, Portwell, SD-Omega, Acrosser, Nexcom…).

2.7.3. Price

Around 1000 euros.

2.7.4. Use in TeleFOT test sites

In detailed FOTs

2.7.5. Processing and memory capacity

CarPCs have typically low power (Intel Celeron, Intel ATOM, VIA C7) processors with a frequency of 1 GHz and 1 GB of RAM memory

2.7.6. Power consumption

Typically a 160W power supply unit (DC-DC converter) are used.

2.7.7. Environment certification

CarPCs usually can stand wide range of temperature (-20; +80°C), humidity and vibrations (e.g. up to 2Grms). They usually have CE, FCC, ROHS certifications. They usually comply with Electromagnetic compatibility (Bluetooth, WIFI)

2.8. Safety and security devices.

Safety & security devices include:

- Active safety devices: these are activated by the occupant (e.g. the seat belt)
- Passive safety devices: they operate without any input or action from the vehicle occupant. Some devices are borderline, such as head restraints, which move to a position optimal for preventing neck injury when a collision is imminent
- Security devices, such as sirens, antitheft devices, alarms, locking systems, GPS-based, immobilizer, remote alarms or lock/unlock...

2.8.1. Maturity

These devices are available on the market and technically mature, though being continuously updated (e.g. the evolution of ABS technology)

2.8.2. Availability

These devices are available on nearly all vehicle segments, possibly except the smallest ones.

2.8.3. Price

Anywhere in the range for tenths to thousands of €s.

2.8.4. Use in TeleFOT test sites

Yes, when embedded in cars. It is not expected to install on-board additional devices of this type.

2.8.5. Processing and memory capacity

n/a

2.8.6. Power consumption

n/a

2.8.7. Environment certification

Devices are usually certified CE, ROHS, FCC, CCC.

2.9. Infrastructure equipment

The complexity of the road network in a city makes it obvious that several infrastructure pieces of equipment are needed in order, not only to manage and organize the city traffic, but also to achieve the maximum performance and efficiency of the road network.

In that sense all cities are equipped with the necessary infrastructure equipment to monitor and manage the traffic of the city, especially in some of the most conflictive parts of the road network, such as intersections, tunnels, areas restricted to traffic, etc.

Most of the times these infrastructure elements do not work isolated, but are part of a system that controls the infrastructure with some sort of intelligence, for example, a traffic light priority system, an urban traffic control system or a tunnel control system.

2.9.1. Maturity

The infrastructure equipment technology is completely mature, so are the control systems, although they are evolving continuously.

2.9.2. Availability

The equipment and systems are available on the market.

2.9.3. Price

The price may range from hundreds of euros for a single piece of equipment to hundreds of thousands of euros for complete systems, including controlling devices (such as central DB, PC).

2.9.4. Use in TeleFOT test sites

Yes, all test sites drivers will interact with this infrastructure equipment, as long as they are part of the road network infrastructure.

2.9.5. Processing and memory capacity

The single piece of equipment may carry from null processing/ memory capacity to the level of a small PC.

2.9.6. Power consumption

Variable, with respect to the processing/ memory capacity of the device.

2.9.7. Environment certification

The certification for these devices may range from IP53 (external webcams) to IP 66 (road-level road-side units).

3. FUNCTIONS IMBEDDED IN SERVICES

In this chapter a study of mobile traffic information and functions or services brought to drivers and travellers on the move is presented.

The study will be focused on the impacts and improvements on travel behaviour, needs and features. Those studies must be continuous during the project. Some target services are:

- Navigation assistance, new features, time tabs, smart traveller guide, seamless / indoor
- Assistance in keeping speed limits, situational speeds (speed alert etc.).
- Weather & road condition information & warning (general, targeted).
- Incident, accident information & warning, LDW.
- Train warning (unguarded level crossings).
- Congestion information.
- Floating Car Data (FCD).
- Security information: car theft.
- Support sober driving /prevent driving under the influence (Alcolock).
- Non -driving related services.
- Road user charging.
- Remote diagnostics.
- Seamless traveller support.

For each element a series of issues have been studied and reported in this deliverable (maturity, availability, price, platform, provider, implementation and legal issues, scalability, infrastructure requirements, communications, use in TeleFOT test sites)

3.1. Navigation assistance with extended functionality

New functionalities for navigation assistance are available on the market which make driving not only safer and greener but also enable a better adaption to the driving task. There are several functionalities to mention in this context:

- Actual speed limit information (cp. chapter 3.2)
- Suggestions to drive in an economic and fuel-efficient way
- Detailed information about lane change
- Safety instructions
- Choice of navigation type
- Seamlessly integrated 'vehicle navigation', 'parking guidance' and 'public transport navigation'

The functionality of speed limit information and speed alert is described in chapter 3.2.

Because nowadays fuel-efficient driving becomes more and more important there is an imbedded service regarding this issue. The routes are not only chosen in respect of the shortest or fastest way but also in respect of a fuel-efficient and by association with an economic way. Beside this function implemented as an extended functionality into a navigation device, there are also applications available which concentrates only on the driving behaviour such as accelerator pedal position or gear use. The application advises the driver to drive in a more economical way. The third mentioned function should support the driver at unclear intersections or during a lane change especially on motorways. A detailed view of the upcoming lane change is provided to the driver to make the choice of the correct lane easier. Another function regarding the safety while driving is to inform the driver about his travel time and useful breaks to prevent falling asleep momentarily. The possibility to choose between several navigation types like 'vehicle navigation', 'pedestrian navigation' or 'public transport navigation' is also available. At the start of the navigation process the driver selects whether he/she would like to navigate the car, walk or navigate through public transportation to the destination. Navigating can be an on-board (PND based) or an off-board solution (smart phone application based). While navigating the car works acceptably well for several years without database updating, navigating through public transportation requires more frequent updates of schedule and route changes. Therefore the off-board solution is more

attractive currently, as PND's lack ergonomic database updating possibility. However since many PND units have Bluetooth capability for hands-free calls, it is anticipated that in near future some infrastructure will be available for automated update of navigation databases into PND devices over Bluetooth link.

Seamlessly integrated 'vehicle navigation', 'parking guidance' and 'public transport navigation' analyses the route from source to destination and decides the optimal choice for the driver: driving to destination, driving to a parking location along the route and continuing through public transportation or taking public transportation all the way. Components of such integrated multi-modal navigator exist today, but not yet in a seamlessly presented form.

3.1.1. Maturity

The basic form of each functionality is available but the version with the best quality still needs to be refined. The maturity of speed limit information is described in chapter 3.2. The possibility to choose between 'vehicle navigation' and 'public transport navigation' is a mature application for smart phones. Currently the driver must start-up the correct navigator instead of choosing the right function within a single application. Another weakness is that the most public transport navigators are geographically limited in scope and fragmented. A seamless navigation solution is still only in experimental stage.

3.1.2. Availability

The vehicle navigation function is available for all countries and for every driver. The public transportation navigation is only available in major urban areas.

3.1.3. Price

For on-board solutions, the price per unit ranges from 80 EUR to 300 EUR. This includes the hardware and the navigation software. There are free and charged solutions available for off-board software. The maximum fee is approximately 150 EUR. This contains only the software without the hardware.

3.1.4. Platform

There are various possible platforms: PDA, smart phone, aftermarket PND (personal navigation device).

3.1.5. Provider

The service provision is managed by a mix of organizations. The manufacturers of PND devices and developers of navigation software for smart phones and PDAs participate for vehicle navigation systems whereas public transportation companies and aggregator of

geographically limited public transportation databases participate for public transport navigators.

3.1.6. Implementation issues

The implementation can be on-board without database updating and off-board based on a centralized database.

3.1.7. Legal issues

There are no legal issues which have to be taken into account.

3.1.8. Scalability

Scalability must be considered especially for off-board navigation implementations and to less extend for implementations with periodically updating of databases into the user's device.

3.1.9. Infrastructure requirements

The on-board solution without database updating possibility does not require any support of the infrastructure. If the device is equipped with the functionality to receive periodic database updating an access to a centralized database is required and also mobile communication (GSM or localized) infrastructure. For off-board implementation an access to a centralized database is also required as well as mobile communication infrastructure.

3.1.10. Communication

For smart phone platforms the communication is based on GPRS which typically serves off-board implementations. The PND and PDA based platforms used to have Bluetooth or similar local connectivity which comes to a periodic database update.

3.1.11. Use in TeleFOT test sites

The navigation assistance system is used in Greece within the scope of TeleFOT (tested under all Greek LFOTs and DFOTs).

The Swedish LFOT2 uses the Garmin nüvi PND with EcoRoute functionality (Green driving support and Green routing).

The Valladolid test site utilizes the BLOM navigation device which provides speed limit information and the possibility to be warned when the speed limit is exceeded.

Some of the extended functionalities mentioned in this section are tested in the Madrid Test site, such as actual speed limit information and suggestions to drive in an economic and fuel-efficient way.

The Finnish LFOT and one of the Finnish DFOTs use a green driving application which advises the driver to drive in a more economical way.

A similar application is used during the Italian DFOT.

3.2. Assistance in keeping speed limits, situational speeds (speed alert etc.)

Typically, assistance in keeping speed limits is bundled with the navigation service and occasionally implemented as a standalone device. The current speed limits are shown in the display and the most devices offer the possibility to choose if the driver wants to be warned while driving above the speed limit or not (speed alert). Additionally, the threshold can be chosen when the warning should occur (e. g. current speed limit + 10 km/h). There are multiple quality levels of informing speed limits for safer driving. Static navigation devices are equipped with a database which contains the speed limits. While using the device for several years the original speed limit database gets eventually outdated and lacks situational aspects completely. An improvement regarding this issue is a periodic database update. This implementation keeps the speed limit database up-to-date but also lacks situational aspects and temporary restrictions. Centrally and locally broadcasted situational data consider exactly these situational aspects and temporary restrictions. The real-time broadcasts keep speed limits assistance informed of weather-related effects for the actual area or temporary restrictions for a certain road. The central broadcasts are implemented through a geographically limited broadcast technology, such as RDS-TMC. The advantage of local broadcasts is that such infrastructure can be activated when needed even without centralized coordination. These services can be implemented through a localized geographically limited broadcast technology, such as 5.9 GHz 802.11p.

3.2.1. Maturity

The assistance in keeping speed limits is part of most navigation applications. They differ only in the manner how to update their speed limit database. A periodic updating of the database is only available for limited regions (such as Sweden) and a limited number of compliant applications. Centrally broadcasted situational data is still in experimental stage just as locally broadcasted situational data.

3.2.2. Availability

The basic implementation with a fixed speed limit database is available for all regions. The service for periodically updated speed limits is only available in some regions (e. g. Sweden).

3.2.3. Price

Typically, assistance in keeping speed limits is part of navigation service and it has no associated additional price. Standalone speed limit assistance devices are priced at about 70 EUR per unit.

3.2.4. Platform

The possible platforms are the same as mentioned for the navigation assistance in chapter 3.1. In addition, aftermarket standalone devices with speed limit assistance exist as well.

3.2.5. Provider

The service provision is managed by a mix of organizations. Providers of navigation devices or software participate for the in-vehicle implementations and road operators for maintaining the centralized speed limit database and broadcast infrastructure.

3.2.6. Implementation issues

The implementation can be including some of the four following functional layers: installed on-board database of speed limits, periodically speed limit database updating, reception of centrally broadcasted situational speed limit data or reception of locally broadcasted situational speed limit data.

3.2.7. Legal issues

The accuracy of speed limit assistance can potentially have implications for insurance pay-out in the case of accidents.

3.2.8. Scalability

Scalability must be considered for periodically updating of the speed limit database which involves collecting of a large number of vehicles for receiving the update. Furthermore the scalability of broadcast technology determines the geographical resolution of provided situational speed limit advising.

3.2.9. Infrastructure requirements

There are more complex requirements on the infrastructure if updates should be available. For a periodically updating of the speed limit database or centrally broadcasted

situational data centrally maintained situational speed limit data is required along with communication services or broadcast communication interfaces. For locally broadcasted situational data locally maintained situational speed limit data is necessary along with local broadcast infrastructure.

3.2.10. Communication

The required communication depends on the level of the service. For periodically updating of speed limit information GPRS is needed. Centrally broadcasted situational data is distributed via RDS-TMC. 802.11p media over 5.9 GHz is used for localized broadcast of situational speed limit data.

3.2.11. Use in TeleFOT test sites

The navigator used in the Greek test site within the scope of TeleFOT provides assistance in keeping the speed limits, in the sense of speed limits information and speed alerts provision (tested under Greek LFOT02 & LFOT03 and also in some Greek DFOTs). In the Swedish LFOT1, a standalone product for speed limit information and speed alert is integrated with green driving support.

The Swedish LFOT2 uses a navigator which also provides speed limit information.

In the Swedish LFOT3, the speed limit information and speed alert is integrated in an offboard navigation application for mobile phones.

The speed limit information function is tested in the Madrid test site and the Valladolid test site has additional speed limit alert provided from the navigation device of BLOM.

A part (1/3) of the Finnish LFOT uses a speed limit information function and a speed alert function. One of the Finnish DFOT (TeleISA) uses also speed information service.

3.3. Weather & road condition information & warning

The system informs the driver about the weather during the trip and gives a forecast. It warns the driver in case of adverse road or weather conditions to avoid critical situations.

3.3.1. Maturity

The system is tested in different countries (US, FI) but it is not implemented in commercially available systems yet.

3.3.2. Availability

The system will be available for users of nomadic devices providing these functions.

3.3.3. Price

There is no price available by now.

3.3.4. Platform

It will be a mobile or a fixed device.

3.3.5. Provider

The provider could be traffic authorities.

3.3.6. Implementation issues

The system will be mounted on or inside the dashboard or on the windscreen.

3.3.7. Legal issues

The course of the car can be tracked by the GPS data and transmitted with the vehicle information.

3.3.8. Scalability

There is no information about scalability available.

3.3.9. Infrastructure requirements

Several base stations along the road network are necessary. The devices inside the vehicle must be equipped with a radio receiver and/or transmitter and a central server is required for data handling and processing.

3.3.10. Communication

The system has to communicate with the infrastructure (base station, central station) and depending on the system layout with other vehicles.

3.3.11. Use in TeleFOT test sites

This system is used at the Finnish test site within the scope of TeleFOT.

3.4. Incident, accident information & warning, LDW

The system determines the position of the own vehicle via GPS and gets the information about neighbouring vehicles position via car to car communication. With these data the system can extrapolate the course of the vehicles and warns the driver in case a collision is to be imminent.

3.4.1. Maturity

This system is still under development and not matured by now.

3.4.2. Availability

This system is not available by now.

3.4.3. Price

There is no price information available.

3.4.4. Platform

It will be a mobile or a fixed device.

3.4.5. Provider

Manufacturer of the devices will be the providers.

3.4.6. Implementation issues

The system will be mounted on or inside the dashboard or on the windscreen.

3.4.7. Legal issues

The course of the car can be tracked by the GPS data and transmitted with the vehicle information.

3.4.8. Scalability

There is no information about scalability available.

3.4.9. Infrastructure requirements

All cars attending road traffic have to be equipped with the system to ensure a reliable functionality.

3.4.10. Communication

The system has to communicate with other vehicles.

3.4.11. Use in TeleFOT test site

Real time traffic information, including congestions and incidents in the roads, are provided in the Madrid Test site.

The test drivers in the Finnish LFOT have a traffic information service.

The Swedish LFOT2 is also supported by traffic information (TMC).

3.5. Train warning (unguarded level crossings)

The system warns the driver of an approaching train in a safe distance in front of a level crossing by means of a data radio module and sensor networks WSN.

3.5.1. Maturity

The system is tested in different countries (FI, US) but it is not available in commercially systems yet.

3.5.2. Availability

The system will be available for users of nomadic devices providing these functions.

3.5.3. Price

There is no price information available.

3.5.4. Platform

The system is integrated in a mobile navigation device.

3.5.5. Provider

Manufacturer of the devices will be the providers.

3.5.6. Implementation issues

The system will be mounted on or inside the dashboard or on the windscreen.

3.5.7. Legal issues

There are no legal issues which have to be taken into account.

3.5.8. Scalability

There is no information about scalability available.

3.5.9. Infrastructure requirements

One device must be integrated into the train to locate the position of the train and another device must be mounted in the car which contains the digital map and to receive the information about the status of the level crossings. The data is processed in a central data processing server.

3.5.10. Communication

There must be a communication to the central server via GPRS or via another wireless communication channel.

3.5.11. Use in TeleFOT test sites

This function is not and will not be tested within the scope of TeleFOT.

3.6. Congestion information

The system warns the driver of existing traffic congestions in front of him. There are both free and charged systems available. The charged version offers more information to the driver. Early warnings inform the driver about alterations within the situation on the roads and warn for possible obstructions.

3.6.1. Maturity

This system is already on the market in some devices.

3.6.2. Availability

The congestion information is available for users of nomadic devices which provide this function.

3.6.3. Price

The price of this device is about 240 EUR.

3.6.4. Platform

This function is implemented in a mobile navigation device.

3.6.5. Provider

The provider is a TMC operator.

3.6.6. Implementation issues

The system will be mounted on or inside the dashboard or on the windscreen.

3.6.7. Legal issues

There are no legal issues which have to be taken into account.

3.6.8. Scalability

There is no information about scalability available.

3.6.9. Infrastructure requirements

The traffic data must be collected by regional traffic information centres and the information must be distributed via radio stations.

3.6.10. Communication

A one way communication must be installed. Each traffic message is distributed separately.

3.6.11. Use in TeleFOT test sites

This system is used in Greece within the scope of TeleFOT (tested under LFOT03).

Real time traffic information, including congestions and incidents in the roads, are provided in the Madrid Test site.

3.7. Floating Car Data (FCD)

The device generates data out of the vehicle which takes an active part in the transport scene. The data contains the status of the vehicle as well as the vehicle's position. These data is distributed to other road users in an ad-hoc network. The vehicles become mobile sensors and generate helpful information about the road status.

3.7.1. Maturity

This system is already on the market in one device.

3.7.2. Availability

This system is available for users of devices which provide this function. At the moment only one system is available which provides this function (BMW Assist).

3.7.3. Price

The price is depending on the device which is installed in the car. (e. g. navigation system "professional", 3 years: free of charge, afterwards: 250 EUR p. a.).

3.7.4. Platform

The system is available for fixed navigation units.

3.7.5. Provider

The provider of this system is BMW.

3.7.6. Implementation issues

The system is mounted inside the dashboard.

3.7.7. Legal issues

There are no legal issues which have to be taken into account.

3.7.8. Scalability

There is no information about scalability available.

3.7.9. Infrastructure requirements

The traffic data is collected by the vehicles which are equipped with this service. The information is distributed via SMS.

3.7.10. Communication

There must be a two way communication via SMS with the central server.

3.7.11. Use in TeleFOT test sites

This function is not and will not be tested within the scope of TeleFOT.

3.8. Security information: car theft

The system warns the driver in case of entering a crime hot spot. The system displays different risk levels which are determined by police records in combination with the navigation system.

3.8.1. Maturity

This system shall be launched in Japan.

3.8.2. Availability

This system is available for users of devices offering this function. At the moment only Honda offers such a system (“Crime Warning Navigation System”).

3.8.3. Price

The price is unknown.

3.8.4. Platform

The function is part of the fixed navigation device.

3.8.5. Provider

The provider of this function is Honda.

3.8.6. Implementation issues

The system is mounted in the dashboard.

3.8.7. Legal issues

There are no legal issues known which have to be taken into account.

3.8.8. Scalability

There is no information about scalability available.

3.8.9. Infrastructure requirements

For this function there is no infrastructure needed because the functionality only depends on the hardware mounted in the vehicle.

3.8.10. Communication

There is no communication necessary.

3.8.11. Use in TeleFOT test sites

This function is not and will not be tested within the scope of TeleFOT.

3.9. Support sober driving /prevent driving under the influence of alcohol

The objective of the Alcolock system is to lock the ignition of the vehicle if the alcohol level in the driver's breathable air is over a defined limit. To unlock the ignition the driver has to exhale into a measuring head and if his alcohol level is under the limit the engine can be started by the driver.

3.9.1. Maturity

There are Alcolock systems available on the market (Volvo, Dräger).

3.9.2. Availability

The function is available for users of the device or driver of an equipped vehicle.

3.9.3. Price

The price depends on the device which is installed in the car (e. g. Dräger Interlock XT: 1685 EUR).

3.9.4. Platform

The system consists of a fixed central unit which locks the ignition and a measuring device. The measuring device can be wireless or wired.

3.9.5. Provider

The provider is the manufacturer of the device.

3.9.6. Implementation issues

The system is mounted inside the dashboard.

3.9.7. Legal issues

There are no legal issues which have to be taken into account.

3.9.8. Scalability

There is no information about scalability available.

3.9.9. Infrastructure requirements

There are no infrastructure requirements.

3.9.10. Communication

There is no communication needed.

3.9.11. Use in TeleFOT test sites

This function is not and will not be tested within the scope of TeleFOT.

3.10. Non - driving related services

Nearly any nomadic device offer one or multiple non driving related services like playback of music, video playback, hands-free set, games, etc. Some devices can even connect to the internet through a mobile connection. These functions are certainly also available for the passengers. The disadvantage is while using these non-driving related services the function as a navigation device is nearly impractical.

3.10.1. Maturity

There are systems with non driving related services available on the market.

3.10.2. Availability

There are big differences between the availability of services depending on the system.

3.10.3. Price

The price varies and is depending on the system.

3.10.4. Platform

There are mobile as well as fixed devices available.

3.10.5. Provider

The provider is the manufacturer of the device.

3.10.6. Implementation issues

The system is mounted on or inside the dashboard or on the windscreen.

3.10.7. Legal issues

There are no legal issues which have to be taken into account.

3.10.8. Scalability

There is no information about scalability available.

3.10.9. Infrastructure requirements

There are no infrastructure requirements.

3.10.10. Communication

There is only a mobile connection necessary for internet access.

3.10.11. Use in TeleFOT test sites

The nomadic device that is used in Greece within the scope of TeleFOT (Samsung OMNIA II) can offer the aforementioned non-driving related tasks.

The same applies to nearly all mobile or smart phone based application that the device can be used for non-driving related services but these functions are not in the focus of TeleFOT and are not tested.

3.11. Road user charging

In general terms, Road User Charging (RUC) is the charge to the driver for the utilisation of a certain road resource. It has been used for a number of purposes: from the generation of revenue to the control of one or more factors such as congestion or pollution. A typical RUC system consists of a charging system that detects that the car has entered or left a toll road, calculates the driven distance via a GPS receiver and charges a certain amount of money for this distance. The communication between vehicle and the central server can be established via GSM or the onboard unit communicates with toll bridges.

3.11.1. Maturity

These systems are available on the market (e. g. toll collect, ASETA).

3.11.2. Availability

This function is available for users of nomadic or onboard devices providing this function. The system has to be equipped with special GPS, a radio receiver and/or GSM transmitter.

3.11.3. Price

The onboard unit is supplied by the provider (toll collect).

3.11.4. Platform

The system is integrated into the vehicle.

3.11.5. Provider

The provider of the service provides the system.

3.11.6. Implementation issues

The system is mounted on or inside the dashboard or on the windscreen.

3.11.7. Legal issues

The course of the vehicle can be tracked by the GPS data.

3.11.8. Scalability

There is no information about scalability available.

3.11.9. Infrastructure requirements

The system needs toll bridges at several points of the route.

3.11.10. Communication

At least one way communication with the central server or with toll bridges is necessary.

3.11.11. Use in TeleFOT test sites

This function is not and will not be tested within the scope of TeleFOT.

3.12. Remote diagnostics

Remote diagnostics is a function acquiring the awareness about the state of the vehicle from the remote location without the need to examine the artefact by the human being physically present on place.

3.12.1. Maturity

21000 units were shipped in Europe in 2009 so it is going to become mature.

3.12.2. Availability

There is original equipment available from BMW, Peugeot, Renault and Volvo as well as aftermarket systems from Actia, Texa and others.

3.12.3. Price

The price can differ from the original equipment and aftermarket devices. Normally, there is a fixed price for the device and the installation and a monthly/annual fee for the service.

3.12.4. Platform

The system is an in-car equipment.

3.12.5. Provider

The providers of this function are the car manufacturers (for original equipment) or service providers (e. g. fleet managers for aftermarket devices).

3.12.6. Implementation issues

An onboard device cooperates with a server and creates the distributed environment.

3.12.7. Legal issues

Some issues regarding data privacy, human being tracking and dual use must be considered.

3.12.8. Scalability

No new devices will be added if the in-car system device is able to communicate with the CAN network and the main legacy of the car manufacturer.

3.12.9. Infrastructure requirements

There must be a corporate server with a communication function.

3.12.10. Communication

UMTS/GPRS is necessary to exchange the payload with the corporate server.

3.12.11. Use in TeleFOT test sites

This function is not and will not be tested within the scope of TeleFOT.

3.13. Seamless traveller support

During a trip the seamless traveller support should behave as a virtual assistant who is ubiquitously present on place and proactively reacting on the traveller needs. Trips should be planned by this assistant and additional information regarding possible leisure activities in the immediate vicinity should be available on the device.

3.13.1. Maturity

This system is not matured.

3.13.2. Availability

The proof of concept was delivered by the iTravel project.

3.13.3. Price

There is no price available at the moment.

3.13.4. Platform

There must be an end-user representative device including the identification, localisation and context-sensitiveness. Nomadic devices with smart phone, PDA and navigation capabilities plus semantics and the link to the remote server will be used.

3.13.5. Provider

The provider is eMarketplace with the help of telecommunication operators.

3.13.6. Implementation issues

A distributed mobile architecture with the main legacy is running the intelligent algorithms.

3.13.7. Legal issues

Some issues regarding data privacy and the use while driving must be taken into account.

3.13.8. Scalability

An enhanced smart phone might be sufficient but it should cooperate with the in-car system device. The SIM-card identifying the user ensures the use of the GPS device and be connected to the main legacy through the Internet of Things middleware.

3.13.9. Infrastructure requirements

The connectivity should be anywhere. A cheap connectivity with no roaming charges is desirable.

3.13.10. Communication

The connectivity might be an always on connectivity or there must be a polling whenever possible with the middleware supporting IOT paradigm of the discovery of the nodes changing the state. The real time functionality requires an always on connectivity.

3.13.11. Use in TeleFOT test sites

This function is not and will not be tested within the scope of TeleFOT.

3.14. Curve alert

The system recognizes approaching curves and calculates, based on the curvature, the optimum velocity for that curve. If the driver approaches with a higher velocity, he is warned by the system.

3.14.1. Maturity

The function is already on the market in some devices.

3.14.2. Availability

The function is available for users of nomadic devices providing this function. There is no other system needed.

3.14.3. Price

The price of such a system is about 300 EUR (Navigon 7210).

3.14.4. Platform

Normally, it is implemented in a mobile navigation device.

3.14.5. Provider

The provider is the manufacturer of the device.

3.14.6. Implementation issues

The system is mounted on or inside the dashboard or on the windscreen.

3.14.7. Legal issues

There are no legal issues which have to be taken into account.

3.14.8. Scalability

There is no information about scalability available.

3.14.9. Infrastructure requirements

For this function no infrastructure is needed because the data is contained inside the digital map of the device.

3.14.10. Communication

There is no communication needed.

3.14.11. Use in TeleFOT test sites

This function is not and will not be tested within the scope of TeleFOT.

3.15. Environmental zone (fix and temporally limited)

The system shows environmental protected zones in the map.

3.15.1. Maturity

The function is already on the market in some devices.

3.15.2. Availability

The function is available for users of nomadic devices providing this function. There is no other system needed.

3.15.3. Price

The price of such a system is about 400 EUR (Falk F10).

3.15.4. Platform

Normally, it is implemented in a mobile navigation device.

3.15.5. Provider

The provider is the manufacturer of the device.

3.15.6. Implementation issues

The system is mounted on or inside the dashboard or on the windscreen.

3.15.7. Legal issues

There are no legal issues which have to be taken into account.

3.15.8. Scalability

There is no information about scalability available.

3.15.9. Infrastructure requirements

For this function no infrastructure is needed because the data is contained inside the digital map of the device.

3.15.10. Communication

There is no communication needed.

3.15.11. Use in TeleFOT test sites

This function is not and will not be tested within the scope of TeleFOT.

3.16. Seasonal or temporally (time) limitations/ gates

The functionality of seasonal or temporally limitations is already described in 3.2.

3.16.1. Maturity

The function is already on the market in some devices.

3.16.2. Availability

The function is available for users of nomadic devices providing this function. There is no other system needed.

3.16.3. Price

The price of such a system is about 250 EUR (Blaupunkt TravelPilot 300).

3.16.4. Platform

Normally, it is implemented in a mobile navigation device.

3.16.5. Provider

The provider is the manufacturer of the device.

3.16.6. Implementation issues

The system is mounted on or inside the dashboard or on the windscreen.

3.16.7. Legal issues

There are no legal issues which have to be taken into account.

3.16.8. Scalability

There is no information about scalability available.

3.16.9. Infrastructure requirements

For this function no infrastructure is needed because the data is contained inside the digital map of the device.

3.16.10. Communication

There is no communication needed.

3.16.11. Use in TeleFOT test sites

This function is not and will not be tested within the scope of TeleFOT.

3.17. Variable speed limits and speed limits depending on time or weather conditions

The functionality of variable speed limits and speed limits depending on time or weather conditions is also describes in chapter 3.2.

3.17.1. Maturity

Centrally broadcasted situational data is still in experimental stage just as locally broadcasted situational data.

3.17.2. Availability

The situational data regarding time or weather dependent speed limits are not available yet.

3.17.3. Price

There is no information regarding the price.

3.17.4. Platform

The possible platforms are the same as for navigation support (PDAs, PNDs, smart phones).

3.17.5. Provider

Road operators are responsible for maintaining the centralized speed limit database and broadcast infrastructure.

3.17.6. Implementation issues

The implementation of this function will be in a mobile device but the situational data must be available.

3.17.7. Legal issues

There are no legal issues which have to be taken into account.

3.17.8. Scalability

There is no information about scalability available.

3.17.9. Infrastructure requirements

For centrally broadcasted situational data there must be a situational speed limit database with communication services or broadcast communication interfaces. For locally broadcasted situational data locally maintained situational speed limit data is necessary along with local broadcast infrastructure.

3.17.10. Communication

Centrally broadcasted situational data is distributed via RDS-TMC. 802.11p media over 5.9 GHz is used for broadcast of local situational speed limit data.

3.17.11. Use in TeleFOT test sites

This function is not and will not be tested within the scope of TeleFOT.

3.18. Water protection areas for transports of hazardous goods

The system is able to warn drivers of vehicles transporting hazardous goods when they pass through a water protection area or the system directly choose a route without entering any water protection area.

3.18.1. Maturity

There is no information available for the maturity of the system.

3.18.2. Availability

This function is not available at the moment.

3.18.3. Price

There is no price information available.

3.18.4. Platform

The function can be implemented on mobile and fixed devices.

3.18.5. Provider

The provider is the manufacturer of the device.

3.18.6. Implementation issues

The system is mounted on or inside the dashboard or on the windscreen.

3.18.7. Legal issues

There are no legal issues which have to be taken into account.

3.18.8. Scalability

There is no information about scalability available.

3.18.9. Infrastructure requirements

For this function no infrastructure is needed because the data is contained inside the digital map of the device.

3.18.10. Communication

There is no communication needed.

3.18.11. Use in TeleFOT test sites

This function is not and will not be tested within the scope of TeleFOT.

3.19. Submission of vehicle type (e.g. truck, vehicle with trailer or camper)

There are navigators specially thought for their use in specific vehicles like caravans, mobile homes or trucks (with or without tow). They contain specific services and function to support the driver while driving. For example, the system contains information about weight and height limitations at bridges or tunnels. They also have information on streets where the driving of heavy vehicles is not allowed. Some of the most advanced systems contain all relative information about restrictions of height, width, weight, weight per axes, prohibitions and preferences, and restrictions regarding hazard goods. In order to enjoy the advanced functions, it is necessary to introduce the data of the vehicle as well as the load that it carries. Taking all this information into account, they can plan the route without any restriction. They can provide warning information such as steep hills, sharp bends and even crosswind areas. In the case of specific navigators for home mobiles and SUV's, they used to include the possibility of choose the routes for their beauty including off roads.

3.19.1. Maturity

At the moment there are vendors that offer PNDs with specific versions for trucks and campers. They use advanced data from the usual cartography (e. g. Navteq).

3.19.2. Availability

There are different devices depending on the area of application. At the moment, there are devices available for UK, USA, Canada and Europe. These devices have more or less functions depending on the model.

3.19.3. Price

The price is between 450 EUR and 650 EUR.

3.19.4. Platform

The system is generally implemented on navigation devices but there are also software modules available for devices with Windows Mobile (PDAs, smart phones, etc.).

3.19.5. Provider

There are several providers like PTV Loxane, Pronav, Lowrance, etc.

3.19.6. Implementation issues

It is an on-board system.

3.19.7. Legal issues

As conventional navigator devices they must be used only when the vehicle is completely and safely stopped. Manipulation while driving is forbidden.

3.19.8. Scalability

There is no information about scalability available.

3.19.9. Infrastructure requirements

There is no extra infrastructure required because they use the same than other navigator devices.

3.19.10. Communication

There is no communication needed.

3.19.11. Use in TeleFOT test sites

This function is not and will not be tested within the scope of TeleFOT.

3.20. Applicability for pedestrians

On the one hand there are navigator devices which due to their size, weight and their interface are especially designed for pedestrians. On the other hand in some specific areas (e. g. in the city of Nuremberg, Germany) wireless communication which is accessible for any device with WiFi (PDAs, smartphones, laptops, etc.) can be used to access additional information on site. In the first case, these special devices for pedestrians combine the usual functions of any navigator with additional entertainment functions like music and video players, videogames, agenda or customizable interfaces.

3.20.1. Maturity

Specific navigators already exist for pedestrians. Some other conventional navigators have, as an option, the possibility to calculate a route on foot. In the case of navigation using WiFi, there are few areas that can offer that functionality although every day more and more cities in Europe bet for a global and free WiFi network in which specific functionalities for pedestrian can be added.

3.20.2. Availability

In the case of specific navigators for pedestrians, they can be used in the same conditions and in the same areas than conventional devices since they use the same cartography. In the case of WiFi communications, it is restricted to the areas where a WLAN is available. Nowadays there are not many of such areas. As an example, the city of Nuremberg has this service in its streets. Other Europe cities (e. g. Barcelona) has the objective of set up one of this wireless networks.

3.20.3. Price

There are specific navigators for pedestrians from around 300 EUR. The functionality by WiFi can be free or in some regions also charged. The only request is to have a device able to launch it.

3.20.4. Platform

The platform can be a navigation device as well as for WiFi functionality PDAs, smart phones and laptops.

3.20.5. Provider

Some providers (e. g. Fujitsu Siemens) have specific navigators for pedestrians in their catalogues. The functionality of WiFi is provided by city councils.

3.20.6. Implementation issues

The function is on-board for specific navigators and centralized for WiFi functionality.

3.20.7. Legal issues

There are no legal issues which have to be taken into account.

3.20.8. Scalability

There is no information about scalability available.

3.20.9. Infrastructure requirements

There is no extra infrastructure required for specific navigators because they use the same than other navigator devices. A WLAN network is required for WiFi functionality.

3.20.10. Communication

There is no communication necessary for the specific device but WiFi for the other case.

3.20.11. Use in TeleFOT test sites

The system used in Greece within the scope of TeleFOT is also applicable for pedestrian use but it will not be tested in the project.

3.21. Assistance in finding a free (empty) parking place

This functionality has as its goal to inform the driver about available parking places near his final destination. If the operator of the parking site offers this opportunity the driver can reserve a place to make sure that it will be still available when he arrives.

3.21.1. Maturity

At the moment this functionality is under development.

3.21.2. Availability

The development and test of this functionality are taking place in Valencia, Spain.

3.21.3. Price

There is no price defined yet.

3.21.4. Platform

There is no information available regarding the price.

3.21.5. Provider

Several IT providers, such as ETRA can provide these services in the parking places.

3.21.6. Implementation issues

The function is an on-board system.

3.21.7. Legal issues

This functionality has to be used as the rest of the standard functionalities of a navigator. This means that it must not be turned on or off while driving but when the vehicle is completely stopped and under safe conditions.

3.21.8. Scalability

There is no information about scalability available.

3.21.9. Infrastructure requirements

There is no information about the requirements for infrastructure available.

3.21.10. Communication

There is no information about communication available.

3.21.11. Use in TeleFOT test sites

This functionality will not be used in TeleFOT tests.

4. UPCOMING INNOVATIONS

4.1. Infrastructure equipment and on board devices

Every day, more and more vehicles are being equipped with the newest infrastructure equipment and on board devices. These equipments do not act as standalone devices but often are Cooperative Systems. Cooperative Systems are vehicle systems based on vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I) and infrastructure-to-vehicle (I2V) communication technology, which allows the real-time exchange of dynamical parameters among vehicles and with infrastructure. It is foreseen that cooperative systems will provide a significant increase of road safety. But also new functions enhancing mobility and efficiency are possible. Example of I2V applications are warnings issued to the driver when approaching dangerous road stretch (e.g. icy road). More complex examples are the intelligent intersection management, where V2V, V2I and I2V are combined in order to avoid accidents and to improve the traffic flow, or safety critical application where V2V communication may substitute or integrate on-board sensors for implementing ADAS functions like blind spot warning or collision warning.

The lower level communication protocols are based on IEEE 802.11p working in the 5.9 GHz. frequency range. The technology is a revised version of the common WiFi, adapted for mobile applications where dynamic ad hoc networks should continuously be created and modified. For the physical implementation a communication unit should be added to each node (vehicle or road station). This is the specific component to be added, that should also have computational capacity in order to implement the application strategies. The other elements required are GPS and HMI devices (displays, audio messages and/or haptic devices) that could be shared with other existing applications.

A key point in cooperative systems is standardisation. In October 2009 EC published a Mandate (N. 453) which is setting deadlines for the standardisation activities (results expected mid 2012). The mandate has been accepted by ETSI and CEN and the activity is currently (2011) ongoing.

4.2. Functions imbedded in services

A seamless traveller support serves as a basis for innovations like “Connected Drive” from BMW. The driver and the passenger should be convincing of the convenience,

infotainment and safety. A function called “MyInfo” allows the driver to conveniently send destinations and associated phone numbers to the car from the Google Maps website. This let you plan your journey before you even get into your car. The system is able to give information about the nearest restaurant, hotel or shopping mall.

Real Time Traffic Information is included at no additional charge with the navigation system. It provides information about traffic and construction delays and also has the ability to re-route around delays that are longer than 5 minutes [1].

Another “Seamless Localization and Navigation” system is under development of T-Systems. It will be a part in fleet management by Floating Car Data (FCD). With it for example Taxis can localize congestion and other road conditions. A server calculates, by using weather and tracking dates, a ‘hazard-map’. These dates can be broadcasted to the vehicles e.g. by DAB. The car compares his position with the information and warns the driver, if necessary. Another project of T-Systems tries to connect ‘vehicle navigation’ with ‘parking guidance’, ‘infotainment’ and ‘public transport navigation’ [2].

5. CONCLUSIONS

This Deliverable aims to provide an overview of the situation of the new infrastructure equipment and on-board devices of the market, as well as the status of the available functions embedded in the systems.

In order to do this, the present document analyses both the equipment and on-board devices and the imbedded functions from the point of view of status, maturity, availability in the market, price, etc. and indicating its use in TeleFOT test sites.

The information contained in D2.6.2 does not go into a deep analysis of the devices and functions presented. Despite of that, it provides a clear overview of the situation of the new infrastructure equipment and on-board devices available in the market, as well as the status of the available functions embedded in the systems. This kind of information is always necessary to decide which devices and functions are more suitable for the test site purposes even before making a deep technological analysis. This makes the document very useful for those test sites, projects or anyone intending to set up an FOT, as it can be used as a technology guide to be consulted during the first steps of the decision making process.

This deliverable forms part of the outcomes of the “observatory study” performed in WP 2.6 which has the objective of providing a proper insight into what constitutes the potential and limitations of new ICT solutions, infrastructure equipment, on board devices and innovative functions and services that TeleFOT can find in the market.

As can be seen through the document, there is a huge range of possibilities available in the market both for the imbedded functions and the on-board equipment. Besides this kind of technologies and functions are evolving every day and the manufacturer companies bring new innovations to the market continuously. These innovations are progressively being integrated in the vehicles and portable devices.

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