The Fully Networked Car Workshop, Palexpo, Geneva, 5-7 March 2008
Meeting report

The fourth annual workshop on the "Fully Networked Car", organized jointly by ITU, ISO and IEC, was held in Geneva, 5-7 March 2008, in association with the Geneva International Motor Show, one of the world's leading automotive events. The event, which this year attracted some 250 participants, was accompanied by demonstrations of the use of ICTs in the automotive sector, with a focus this year on Honda Racing F1 Team's new 2008 "Earthdreams" Formula One Car.

Wednesday 5 March: Opening session

The workshop was opened by **Mr Malcolm Johnson, Director of the ITU Telecommunication Standardization Bureau**, who welcomed participants and explained the objectives of the event, which are to demonstrate the current state of the art in the use of information and communication technologies (ICTs) in the automotive sector. The theme of this year's event is the contribution that ICTs and intelligent transport systems (ITS) can make to the global combat against climate change.

On behalf of ITU, **Dr Hamadoun I. Touré, Secretary-General**, reminded participants that the UN Secretary-General, Ban Ki-moon, has called climate change the "moral challenge of our generation", and explained that the future aim should be to develop cars that are cleaner and greener. This will not only be good for society but also for the car industry, in conferring an important competitive advantage. He explained a number of ways in which ITU is contributing to this effort, including the recent expansion of the work of the FITCAR (From/In/To Cars Communication) Focus Group, and ITU's hosting of the Advisory Panel for Standards Cooperation on Telecommunications related to Motor Vehicles (ASPC TELEMOV). He also highlighted the recent Technology Watch Briefing Paper on the topic of Intelligent Transport Systems (ITS) which gives a more detailed account of the collaborative work that ITU is conducting in this field.[1] ITU will be holding two symposia on ICTs and Climate Change in Kyoto, 15-16 April, hosted by MIC Japan, and in London, 17-18 June, supported by BT.

On behalf of ISO, **Alan Bryden, Secretary-General,** highlighted three recent meetings that were relevant to the discussion at the workshop:

- The UN Climate Change Conference in Bali, December 2007, which focused global attention on the topic of global warming, where ISO presented its 14000 series of standards which deal, *inter alia,* with the measurement of greenhouse gas emissions;
- The UN Road Safety Forum, held in April 2007, where ISO had announced the development of new standards in road safety for managing fleets of vehicles;
- The Davos Forum in January 2008, which had focused on the power of collaborative innovation, which is a central theme to much of ISO's work, in particular, that of Technical Committee 22.

On behalf of IEC and its Secretary-General Aharon Amit, **Mr Jack Sheldon**, provided an account its work in the field of automotive technologies. It might be imagined that an organization, such as IEC, which is mainly concerned with electrical and electronic technologies would not necessarily be involved in an

[1] The ITU Technology Watch Briefing Report on Intelligent Transport Systems, with a particular focus on the CALM (Continuous Air interface for Long and Medium range communications), was published in October 2007 and is available at: http://www.itu.int/oth/T2301000001/en.

industry which is primarily driven by petroleum. In practice, however, IEC, is involved in a number of ways, notably in the development of hybrid electronic vehicles (through Technical Committee 69), in the development multimedia systems for in-car use, and in the application of standards for life-cycle management of electrical and electronic components. He announced that IEC would be holding a workshop later in the year which would bring together the work of several of its technical committees that are relevant to this topic.

Executive session

The session for keynote speakers was moderated by **Mr Hans W. Gierlich, Head Acoustics GmbH** (Germany), who outlined the main topics of the workshop as a whole, and introduced the keynote speakers.

The first keynote speech was given by **Mr Max Mosley, President of the FIA** (Fédération Internationale de l'Automobile). He called for accelerated standards development to support ICTs in vehicles for improvements in safety, and the mitigation and monitoring of climate change He explained that the F1 industry began looking at the issue of ICT in racing cars as long ago as 1992, when a concern was growing that the rapid development of in-car technology would soon eliminate the need for human drivers. For that reason, a decision was taken to separate the future development of road cars, where driver aids can be used to the maximum, and racing cars where limits should be applied. But, in the area of efficiency and monitoring of environmental impact, it is the racing car industry which is setting the pace. Most racing teams have as many as 300 channels of information flowing between the cars and pit crew and as the complexity of systems grow, their interconnection will become critical. A major change will occur in 2013 when a much wider range of ICTs for enhancing efficiency will be permitted. But there is a chicken and egg dilemma of how to introduce energy efficiency and road safety measures in road cars – manufacturers won't make the technology available as standard until customers demand it, but customers may not be willing to pay for it. He argued that there is therefore a need for government intervention to create fiscal incentives to use the latest advances in ICTs in road cars.

Mr Michael Mayer, CEO Freescale Semiconductor, (USA), one of the sponsors of the event and a market leader in the field of embedded processing, described Freescale's work in the automotive sector. Freescale is working closely with F1 in the development of up to 100 sensors in a motor car, with a bandwidth requirement of up to 500 Mbit/s. As vehicles become more self-aware, with more safety features, this requirement will increase. Three major issues to be addressed in future:

- environmental concerns, associated with climate change, which are now becoming business-critical;
- the need for improved road safety, which will require ever-faster processing times in on-board processors;
- the imperative of constant connectivity between increasingly complex subsystems.

These three issues need to be addressed in tandem. By 2010, it is estimated the ICTs will account for up to 35 per cent of the total costs of a car, and 80 per cent of the innovation. In 1996, a typical car had just 6 processors, but by 2008, this had increased to around 70. Although the automotive sector has not yet reached the level of maturity of other parts of the ICT sector, it is critical that further development be standards-driven. Freescale is supporting standards development work, such as the Flexray consortium (see: http://www.flexray.com/).

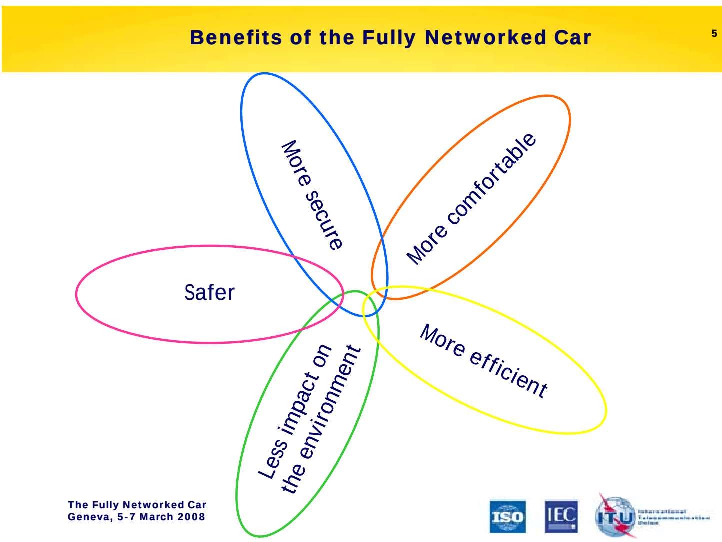


Figure 1: The benefits of the fully networked car
Source: Presentation by Hermann Meyer, ERTICO

Mr Hermann Meyer, CEO ERTICO (ITS Europe). ERTICO is a public/private partnership with some

104 members from industry, public telecom operators, public authorities, research institutes and others. In his presentation, he argued that the fiscal incentives mentioned by Mr Mosley should be linked with the future European legislation on CO_2 emissions. He claimed that the future aim should be to provide cooperative mobility systems. The future benefits of a fully networked car would be that it would be more secure, more comfortable, more efficient, safer and with a lower impact on the environment (see Figure 1). He outlined a number of different standards development initiatives in which ERTICO is involved, including eSafety, SAFESPOT, TISA, i-Travel and CVIS.

Mr Kenji Ikeura, President, Connexis (Japan), one of the sponsors of the workshop, proposed the topic "The always-connected car changes life on board". He argued that ubiquitous and affordable communications are already available in most developed countries, and should now be made available to users when they are also in cars. However, the average lifespan of a car (10-15 years) is much longer than that of a mobile phone (typically less than two years) and this poses a headache for car manufacturers. This will require greater flexibility on the technical side. He presented forecasts from the Telematics Research Group showing that the potential sales of GPS-assisted navigation devices will rise from 50 million per year in 2007 to over 500 million in 2015. For safer driving experience, hands-free operation and a user-friendly interface are essential. This is leading to a paradigm shift from the user-oriented world to the vehicle-oriented world (see Figure 2). One possible platform for this is the Next-Generation Transport Protocol (NGTP: see: http://www.ngtp.org/), which was launched in 2008 (see BMW presentation).

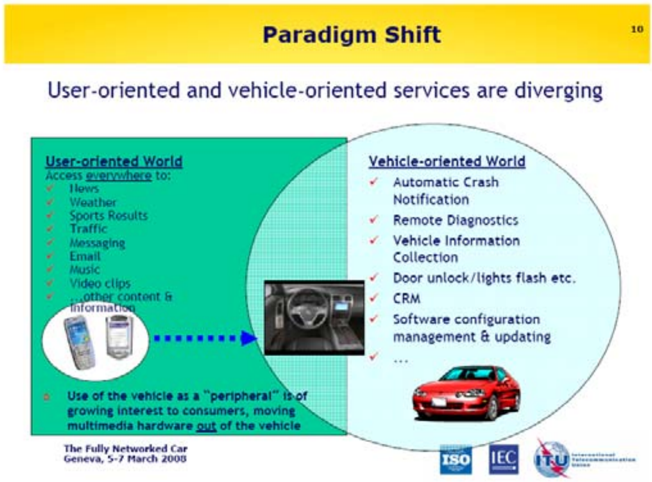


Figure 2: Paradigm shift towards the vehicle-oriented world
Source: Presentation by Kenji Ikeura, Connexis

Mr Oliver Bahns, T-Systems (Germany) addressed the topic of "Connected Life – Networked Car". T-Systems is both a partner in the development of the fully networked car but also a network operator. He argued that today's life often takes place within a "virtual community". This creates a demand for location-based services which link the virtual community to geographical space, and this applies particularly for services to vehicles. The three necessary components of this are connectivity, the human-machine interface and cost effective solutions. Standardized service platforms are an important component in delivering this vision.

Mr David Butler, Marketing Director, Honda Formula 1 Racing Team (UK) addressed the topic of "Technology, passion and vision" as associated with F1 racing, in which Honda has participated for more than 40 years, over three generations. F1 technology is an R&D melting pot which is helping to shape the future of the industry, with reduction of energy use mandated in cars from 2009 onwards. But F1 must also reflect wider environmental concerns. For that reason, in 2007 Honda launched its "earth dreams" campaign to use the powerful brand platform offered by F1 cars to present a global environmental message. But the programme goes well beyond this to look at environmental impact of every stage of the process. Honda is also seeking to engage fans in the campaign as well as a fund-raising campaign to support environmental charities.

Session 1: ICTs and Climate Change

The first session, covering one the main theme of the conference on ICTs and Climate Change, was moderated by **Dr Tim Kelly, Standardization Policy Division, ITU-T**. He outlined the theme of the session, which looks at how ICTs can be used in the automotive sector to reduce environmental impact and contribute to the global battle against climate change.

Mr Paul Kompfner, ERTICO – ITS Europe, presented on "Green ITS – towards the environmentally-friendly networked car". The three main elements of Green ITS are the car, the infrastructure and the driver. Over time, considerable progress has been made in improving the fuel-efficiency of cars but relatively little progress has been made in infrastructure, and there has been little change in driver behaviour. For this reason, there is a need to take a holistic view of Green ITS (see Figure 3). For instance, there is a need to educate drivers in the practice of "eco-driving", to supplement advances in the technology.

Dr Andreas Schäfer, University of Cambridge, presented a long-term, evidence-based view on the topic of mobility and climate change. Over time, as we have moved from an agricultural, to an industrial to a services-based economy, the energy requirements have changed, and have invariably increased. He proposed a model for analysing the composition of greenhouse gas emissions, based on the passenger kilometres traveled, the energy intensity and the greenhouse gas (GHG) intensity of the fuel used. Detailed studies show that there is an exponential growth in the demand for mobility but at the same time there is a diminution in the public provision of mobility, in which the USA can be seen as a trend-setter (see Figure 4). Unfortunately, this trend is likely to continue as the world's population expands in megacities in the developing world, in which public transport provision is often very limited.

Pierre Malaterre, 4iCOM, posed the question: "Is the connected car a solution for the environment?" He presented statistics on the worldwide production of CO_2 (see Figure 5) and its geographical breakdown. If nothing changes, the usage of petroleum will double between 2007 and 2030 and this could be multiplied by three if all the world's citizens are to enjoy the same level of mobility currently experienced in the developed world. Ultimately, therefore, telematics and the application of intelligent transport systems

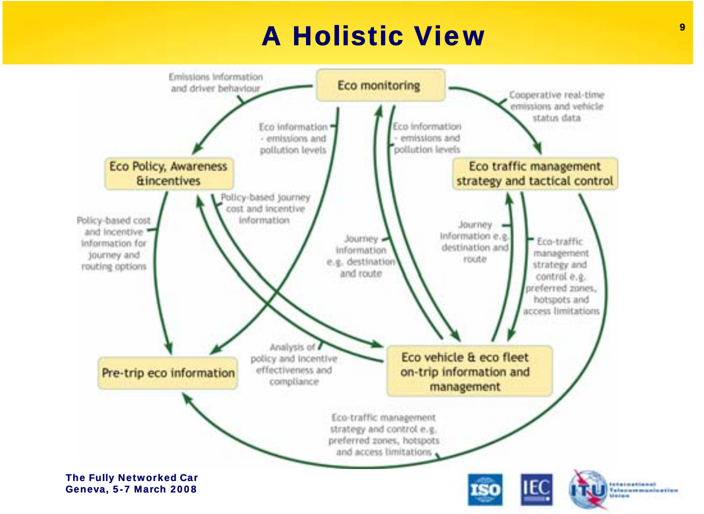


Figure 3: A holistic view of Green ITS
Source: Presentation by Paul Kompfner, ERTICO

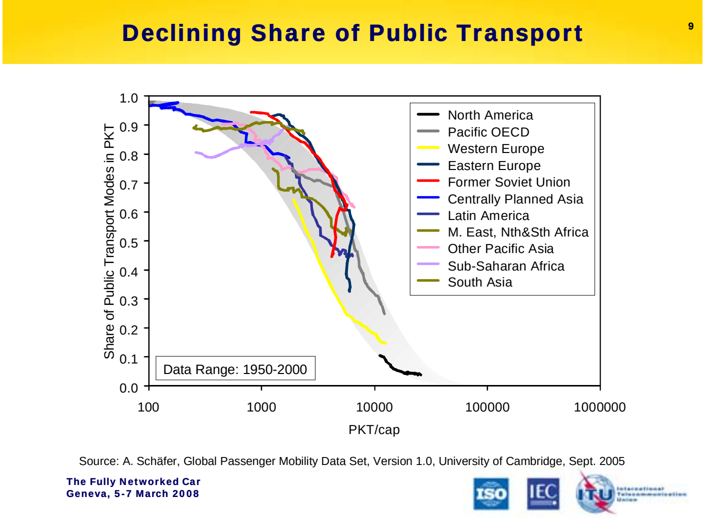


Figure 4: The declining share public transport in mobility
Source: Andreas Schaefer, Cambridge University

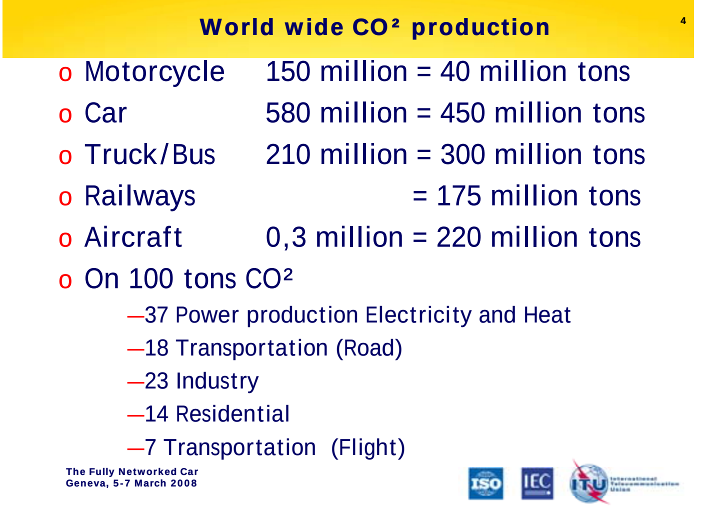
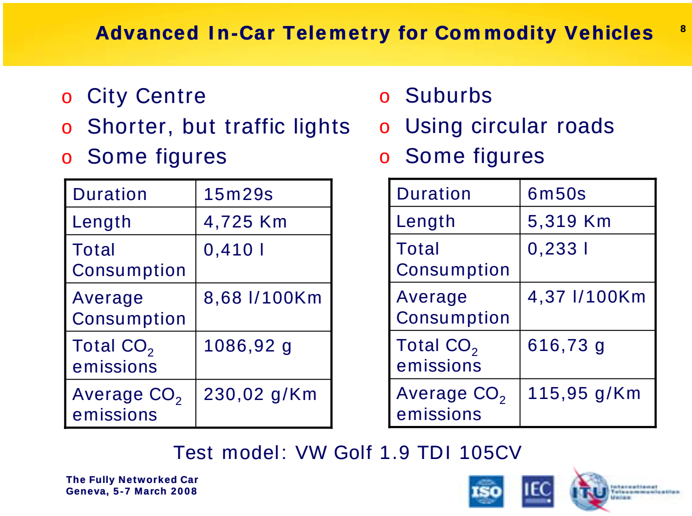


Figure 5: Worldwide CO2 production
Source: Pierre Malaterre, 4iCOM

(ITS) offer the best solution for improved fuel efficiency. ICTs can also supplement other behavioural measures, such as the move to "eco-driving". Other ways of reducing the consumption of oil include the more efficient use of road infrastructure and fostering multimodal transport. In conclusion, although there is scope for economizing around 20-50 per cent of the energy currently being used, this will require must higher investment in infrastructure, greater education of drivers and increased standardization efforts in the area of ITS.

Mr Takashi Sugano, Nissan Belgium, presented research evidence from Japan on the development of eco-driving, drawing upon the use of the CARWINGS Telematics service. For instance, CARWINGS can calculate the fastest route, with least congestion, and can also make suggestions to the driver to improve the driving style. Typical improvement in fuel consumption is 16-19 per cent.

Mr Carlos Busnadiego, GMV, presented on "Advanced in-car-telemetry for commodity vehicles". In particular, he focused on the potential of GNSS (Global Navigation Satellite System) as a platform for ITS in reducing operational costs and improving, flexibility, scalability and interoperability. The analysis of data from GNSS should assist in determining the most efficient path for a particular journey and on influencing driver behaviour and allowing the driver to maximize the energy efficiency of the car. Average CO_2 emissions for city centre journeys can be twice that of similar journeys taken via a suburban route (See Figure 6). It does not always follow that the longer journey is less fuel efficient. Such green policies are likely to prove particularly useful to fleet managers. GNSS technology also provides a possible basis for "pay as you pollute" road pricing schemes. A reasonable target would be to reach a level where all cars are using less than 130 g of CO_2 per km traveled by 2012.



Duration	15m29s
Length	4,725 Km
Total Consumption	0,410 l
Average Consumption	8,68 l/100Km
Total CO_2 emissions	1086,92 g
Average CO_2 emissions	230,02 g/Km

Duration	6m50s
Length	5,319 Km
Total Consumption	0,233 l
Average Consumption	4,37 l/100Km
Total CO_2 emissions	616,73 g
Average CO_2 emissions	115,95 g/Km

Figure 6: Examples of different CO2 emissions for different routes
Source: Carlos Busnadiego

Session 2: Communications, Spectrum and Standards (Part 1)

This session was moderated by **Mr. Reinhard Scholl, Deputy Director, ITU Telecommunication Standardization Bureau**, who introduced the theme of the session, which is close to the heart of the World Standardization Collaboration (WSC), the partnership between ITU, ISO and IEC which is organizing this workshop. He also introduced some of the key players in the standards development work in those organizations.

Mr Jean-Yves Monfort, France Telecom and ITU-T SG 12 chair, opened the session with a summary of recent changes in ITU's Standardization and Radiocommunication work which is relevant to the theme of the workshop. The ITU-T FITCAR Focus Group has formally completed its work, but will reform as a new Focus Group, CARCOM, with an expanded mandate to cover wideband speech and other voice services. Its first meeting will take place in June 2008. ITU-R Study Groups have also been restructured and ITS now falls under Working Party 5A of Study Group 5. A new study question has been defined as "To what extent can evolving mobile communications be used to deliver ITS services?" For the future, it may be possible to envisage the creation of an inter-sectoral coordination group (ICG) on the fully networked car.

Ms So-Yeon Lee, Electronic and Telecommunications Research Institute (ETRI) (Republic of Korea) addressed "Standards for the vehicle gateway". She looked at five specific set of standards:

- Autosar (Automotive Open System Architecture: see www.autosar.org);
- OSGi-VI (Open Service Gateway initiative – Vehicle Interface)
- AMI-C (Automotive Multimedia Interface collaboration: see: www.ami-c.org) Vehicle Gateway, implemented as standard ISO 22900
- M-VCI (Modular Vehicle Communication Interface) implemented as standard ISO 22902
- Car gateway for V21 MYCAREVENT (Mobility and Collaborative work in European Vehicle Emergency Networks)

She argued that there is a need for an overall standards framework for collecting vehicle probe data in an efficient manner.

Martin Arndt, European Telecommunication Standardization Institute (ETSI), described the work of his organization in connecting cars. ETSI has around 700 members from 60 countries. ETSI standardization work includes:

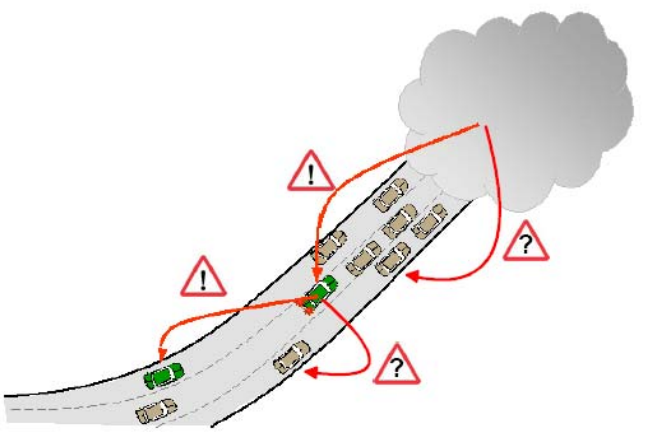


Figure 7: Do they understand each other?
Source: Martin Arndt

- Vehicle to vehicle (V2V) and vehicle to road (V2R) communications, where the 5.8 GHz spectrum has been allocated within Europe.
- Automotive radar, which incorporates anti-collision radar and adaptive cruise control (ACC).
- Electronic fee collection, incorporating dedicated short range communications (DSRC) and the European Electronic Toll Service (EETS).
- A new technical committee, TC ITS, was created at ETSI in October 2007, with five working groups.

He contrasted the situation in ITS with the mobile phone work, where handsets from any manufacturer can communicate with each other. In the automotive sector, however, a lack of standards is preventing the development of safety applications between cars from different manufacturers (see Figure 7).

In discussion, following this session, participants focused on what should be the priorities for future standardization work. One area would be common standards for the full range of nomadic standards, while another issue is standards for software reconfigurable radios (i.e. radio devices that can be reconfigured on the move, to assist with closing the gap between the different life cycles of mobile phones (short) and cars (long). A third topic is privacy, where there is a need for some common understandings about reasonable guidelines for data disclosure, collection and retention.

Day 2: 6 March 2008

Session 3: Communications, spectrum and standards (part 2)

Day 2 of the workshop opened with a continuation of the theme "Communications, spectrum and standards" with a session moderated by **Mr Pierre-André Probst (Ofcom and chair of ITU-T Study Group 16).** He contrasted the bottom-up approach to a standardization work with a top-down approach, dealing with systems as a whole.

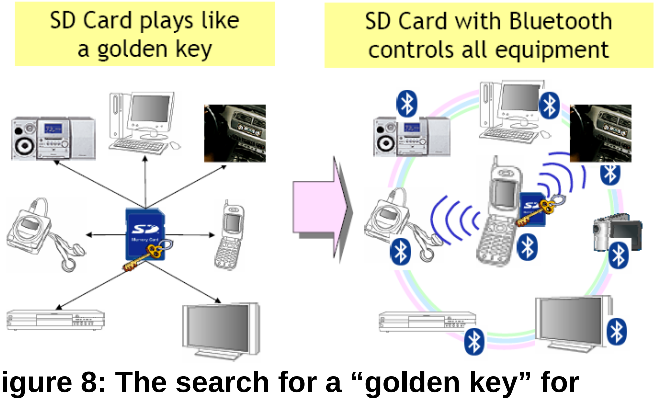


Figure 8: The search for a "golden key" for multimedia content delivery
Source: Shuji Hirakawa

Mr Shuji Hirakawa (Chair of International Electrotechnical Commission, Technical Committee 100) presented on "Audio, video and multimedia standards for the fully networked car". IEC TC100's responsibilities cover home networking as well as audiovisual content mobility between the home and vehicle and *vice-versa*. He outlined the work of the Digital Living Network Alliance (DLNA), which sets out an interoperability framework for content sharing. Until now, much of the media in cars was still analogue (e.g. analogue radio and TV broadcasts, cassette players). As media in the home shifts to digital, so too will in-car entertainment. Recent developments in content delivery include digital broadcasting, optical discs, MP3 players, mobile devices with a Bluetooth connection, and via flash memory cards. In the future, an SD Card may act like a "golden key" to share content among multiple devices and, combined with Bluetooth, to control content on different devices; both in the home and in the car (see Figure 8).

Dr John Chapin, Vanu Inc, and chairman of the Software Defined Radio (SDR) forum presented on "SDR for motor vehicles". The SDR forum is an international consortium with more than 100 members. Software defined radio contrasts with more conventional hardware defined radio, where the functionality is fixed (see Figure 9). SDR is particularly appropriate for the motor industry, which typically has much longer product life cycles than the ICT sector, a requirement to accommodate standards variations between countries and multiple radio devices within the vehicle. SDR is already in wide use in some areas, such as military radio and satellite modems, and is now being used in commercial infrastructure and mobile handsets. Waveform flexibility (built into digital signal processors) is currently more advanced that frequency agility as a means of delivering SDR. The key recommendation for standards-makers is to select an open standard for the digital interface between the digital signal processor and the radio frequency (RF) head. Unfortunately, the existing standards (e.g. OBSAI, CPRI, DigRF) are not appropriate for automotive use. In conclusion, SDR is already available for automotive use, but some major standards challenges remain.

Figure 9: Software-defined and hardware-defined radio
Source: John Chapin

Dr Thierry Ernst, INRIA (The French National Institute for Research in Computer Science and Control**)** discussed the "Impact of IPv6 on the ITS Sector". Internet protocol (IP) provides a unifying layer among different underlying technologies and ensures also interoperability, portability and a wider deployment of equipment. However, the existing IPv4 is inadequate for ITS deployment, due to the shortage of address space (which may run out around December 2009) and the lack of support for mobile usage and network mobility (NEMO). IPv6, which dates from 1995, is the appropriate evolution, but there are costs associated with ensuring compatibility between IPv4 and IPv6, and a lack of applications. IPv6 will meet the scalability concern associated with fully networked cars (which will require millions of individual addresses). It is already used in the CALM series of standards developed by ISO Technical Committee 204, Working

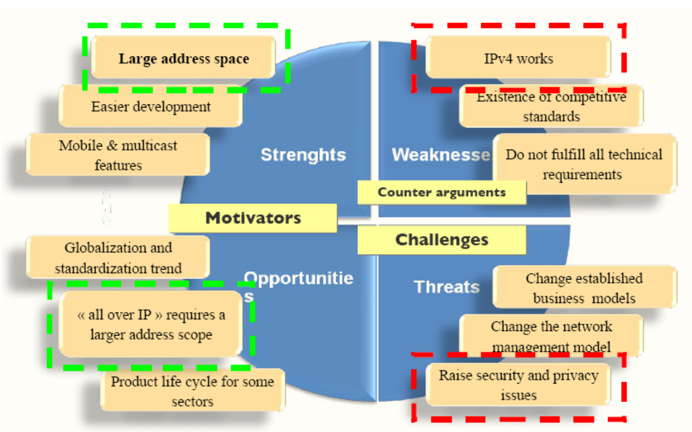


Figure 10: SWOT analysis of IPv6
Source: Thierry Ernst

Group 16. There is a need, therefore, to raise awareness of IPv6 in the ITS community. He noted that an IPv6 impact case study which was recently presented to the European Commission looking at different vertical sectors, including transport. As part of the study, a strengths/weaknesses/opportunities/threats (SWOT) analysis of IPv6 had been carried out (see Figure 10). He concluded that the transition to IPv6 is inevitable and its implications should be considered right now.

Session 4: Car-to-car communication

The next session, on car-to-car (C2C) communication, was moderated by **Mr Jean-Yves Monfort, France Telecom and ITU-T SG 12 chair.**

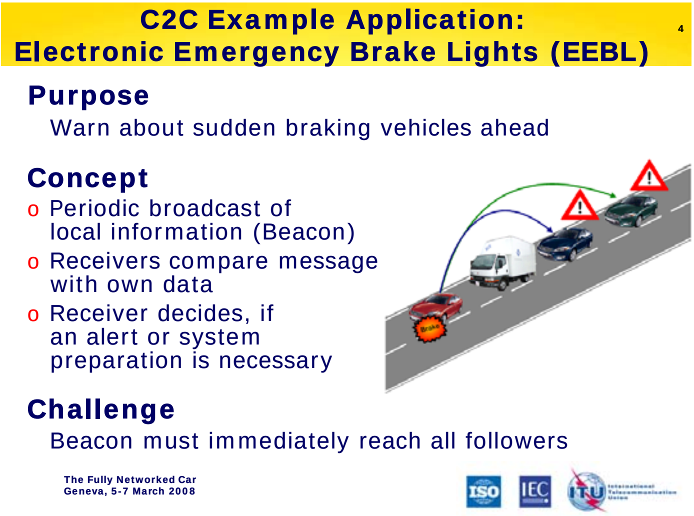


Figure 11: Electronic emergency brake lights

Source: Martin Wieker

Mr Martin Wiecker, Ford automotive research centre (Germany) presented on "Car-to-car communication from the perspective of a global original equipment manufacturer (OEM)". The goal is to establish safe and intelligent mobility. A good example of C2C are Electronic Emergency Brake Lights (EEBL) which are intended to warn drivers about vehicles ahead that are suddenly braking (see Figure 11). This particular application can be established using the IEEE 802.11p standard, also known as WAVE (Wireless Access in a Vehicular Environment). One problem identified in trials is channel overload. Trials suggest an upper limit of 50 channels. Multi-hop communications could assist.

Mr Alberto Los Santos, Telefónica I+D (Spain), presented on "Performance comparison between Ad-hoc on-demand distance vector (AODV) and Optimized Link State Routing (OLSR) in Vehicular ad-hoc network (VANET) scenarios". VANETs are a subset of mobile ad-hoc networks (MANETs). The main difference between the two options is that OLSR is proactive whereas AODV is reactive. Field tests have been conducted with numerous scenarios. This shows that the performance of the two routing protocols varies according to the network load with OLSR performing better with a higher load network while AODV does better where the network load is lower.

Dr John JungHoon Lee, Telcordia Technologies, presented on "Dynamic Vehicle Group architecture for vehicle to vehicle (V2V) and vehicle to road (V2R) communications". With rapid penetration of wireless access and information processing technologies changing the way that vehicle users communicate, significant research efforts have been aimed at improving vehicle safety and on-demand information access. The key vehicle communication performance requirements include low latency, high message delivery ratio, and data security in order to support vehicle applications. Communication protocols need to overcome topology-related issues, influenced by mobility and the wireless communications conditions as well as lack of inherent relationships among vehicles. Much recent research has been directed at seamless networking technology to effectively utilize heterogeneous communication media for vehicle users, and ad hoc networking technology for vehicle-to-vehicle (V2V) and vehicle-with-roadside (V2R) communications. Dr Lee presented an outline of the dynamic vehicle group architecture and highlighted key technical approaches (e.g., vehicle-to-vehicle multicasting, vehicle-with-roadside networking, and inter-vehicle-groups communication). Finally, computer simulation results, as well as simulation-based demos, were presented showing the favourable performance of this solution.

Session 5: Car to X communications

This session, moderated by **Paul Kompfner (ERTICO – ITS Europe),** extended the discussion of the previous session on C2C to discuss also communications with vehicles and other entities, e.g., infrastructure.

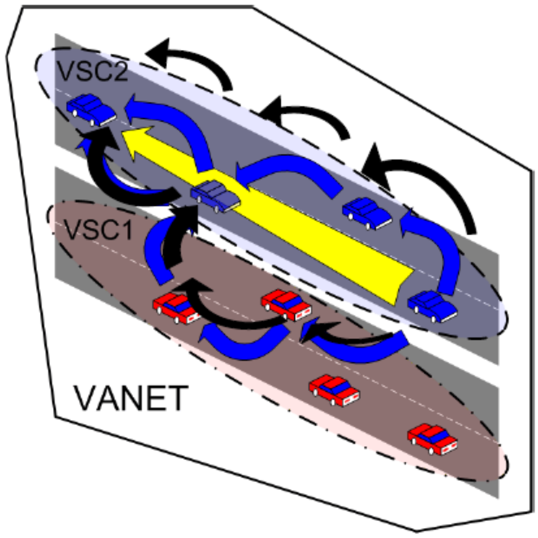


Figure 12: Car-to-car communications, creating a virtual sub-centre (VSC) within a vehicular ad-hoc network (VANET)
Source: Chaban Gabay

Dr Chaban Gabay, Motorola (USA) addressed the topic of the "Virtual sub-centre: safety concept for European road transport". Specifically, he presented the current status of work on COM2REACT (see http://www.com2react-project.org/) which is a European research project building upon earlier work done on REACT. The main objective is to develop a traffic efficiency and safety system through communications among entities on a virtual sub-centre (VSC). Within a cluster of vehicles and other entities, a vehicular ad-hoc network (VANET) is created and one of the cars assumes the position of "master" within that VANET (see Figure 12). Data and trials indicate that COM2REACT can address around 13 per cent of current road traffic accidents, namely those that would be alleviated by collision warning by locating obstacles (5 % of the total), environmental monitoring and prediction (6%) and collision warning by prediction of congestion back-ends (2%).

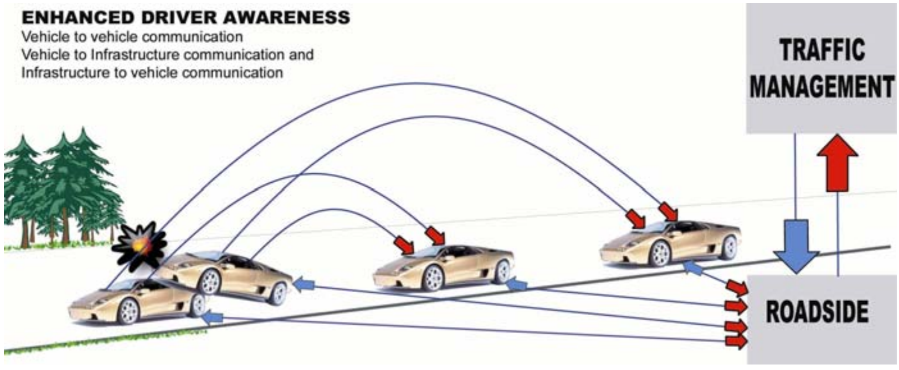


Figure 13: Enhanced driver awareness
Source: Simon Coutel

Mr Simon Coutel, INRETS (the French National Institute for Transport and Safety Research) addressed the topic of "A cooperative application for enhanced driver awareness (EDA)". This research arises from the Cooperative Vehicle Infrastructure Systems (CVIS) project, which is in turn based on IPv6, OSGi and CALM. EDA is a cooperative safety application intended to keep the driver informed about potential non-regular situations, such as a ghost driver (a car heading in the wrong direction), a dynamic speed limit, and a modification to traffic flow (e.g., due to traffic hazards) (see Figure 13). He went on to present results from test sites in Sweden and France.

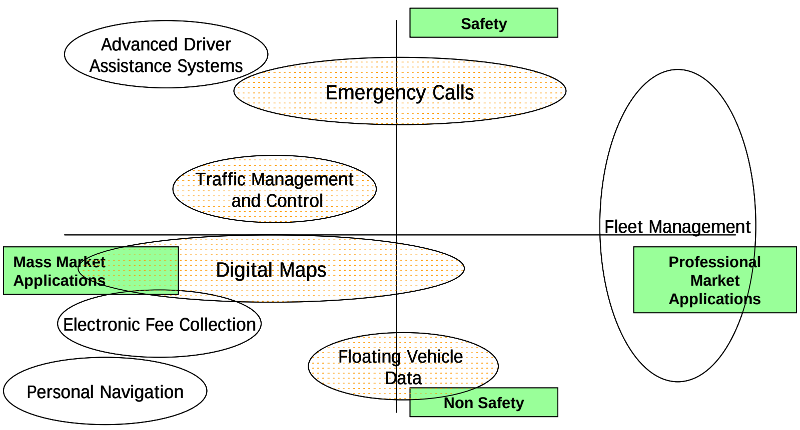


Figure 14: Typical ITS applications
Source: Monica Schettino

Ms Monica Schettino (ERTICO – ITS Europe) addressed the topic of "Satellite communications as a part of the operational implementation of ITS applications". SISTER (satellite communications in support of transport on European roads) is a three-year EU funded research project launched in November 2006 which is closely related to the development of the European GPS system, Galileo. Proof-of concept work for SISTER is being carried out at a number of different field trials including on:

- Digital map updating (in Germany, Austria and Slovenia);
- Electronic fee collection (Czech Republic);
- Emergency call (Ecall, in Sweden);
- Integrated services (Antwerp);
- Enhanced Galileo services (East Midlands, UK).

These are just a few of the potential applications of ITS (see Figure 14), which can be segmented by safety/non-safety and professional/mass-market applications. The advantages of satellite include providing back-up capability, efficient cross-border broadcast mode, improving performance and cost-effectiveness and competitive service provision. One specific standards challenge will be to incorporate satellite communications within the CALM family of standards, and this will be addressed on a one-day special session on satellite communications at the upcoming CALM meeting in Paris, 9-13 June 2008.

Session 6: New telematics delivery solutions

In session 6, which was moderated by **Kevin Borras,** a UK-based journalist, the focus shifted back to telematics, and their delivery to vehicles.

Mr Takeshi Imai, Honda Motor Company (Japan) presented Honda's "InterNAVI premium club", a location-based system for vehicle navigation. It has exceeded 350 million km since launch in 2004. Services include:

- Major roads, real-time map updates;
- Disaster prevention information (e.g., storms, earthquakes);
- "Floating car information", which is a system for sharing traffic information among members.

A real-life example was provided following the Nigata Chuetuoki earthquake on 16 July 2007, when a map of passable roads was posted to the Honda website based on driver observations.

Mr Felipe Gil, University of Vigo (Spain), presented on "Automotive middleware support for data transfer from Web 2.0 to user interfaces via nomadic devices". He began by posing a dilemma: The user demand for in-car information devices continues to grow (e.g., satnavs, multimedia entertainment, mobile phones etc: see Figure 15), but they become outdated quickly. The proposed solution is for data transfer to the vehicle using a nomadic commercial device. The basic assumptions are that the device should be securely fitted and would require a minimum of driver interaction. The five key components would be OSGi (a standardized platform for Java-based applications), Google maps, a Firefox browser, a mobile phone and an embedded device.

Figure 15: The overcrowded dashboard
Source: Felipe Gil

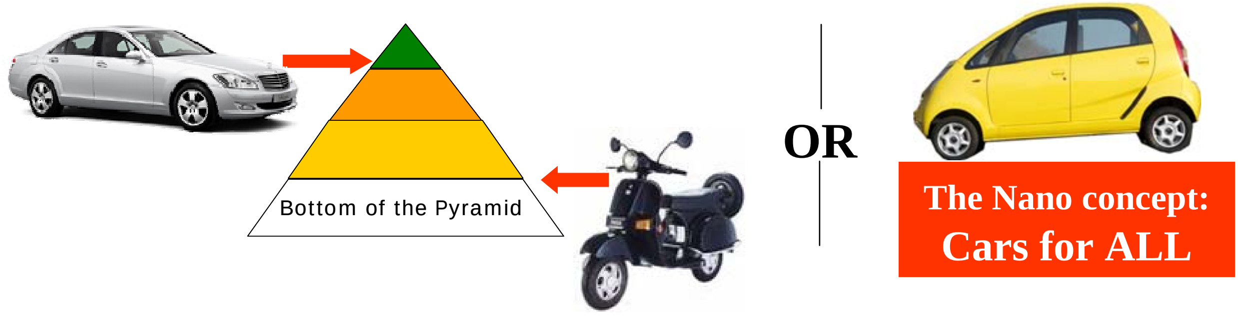


Figure 16: The cars-for-all concept
Source: G. Venkatesh

Dr G. Venkatesh, Sasken Communication Technologies Ltd, talked about the exciting opportunity presented by "Convergence of telematics and infotainment in emerging markets". Inspired by Tata's cars-for-all concept for "bottom of the pyramid" customers, exemplified by Tata's Nano car (see Figure 16), he asked whether it might be possible to apply the same principles to automotive electronics. The traditional approach, whereby the rich are served first, might be described as trickle down, whereas the bottom of the pyramid model would foresee a bubble-up approach, as happened in India, for instance, with cable TV. A "telemetry for all" model, for instance, would require usage fees below US$2 per month and an upfront device cost below US$80. Ways of reducing costs include non-real-time information delivery, broadcast delivery modes (e.g., FM radio) rather than point-to-point and collaborative information sharing, for instance using a human information traffic information resource. Overall, the intention is to focus on services for the "common man", with a focus on affordability.

Mr Axel Moering, BMW ConnectedDrive (Germany) addressed "Next generation telematics protocol (NGTP): rethinking telematics service". BMW ConnectedDrive's current products include a GoogleMaps based navigation service. The future challenges include reducing barriers to implementation and collaboration, enabling adoption of new technologies as they come online, developing leading-edge products, supporting legacy systems and offering global solutions tailored to local needs. NGTP provides some answers to these needs and was formally launched by BMW in January 2008. It could be a candidate for future standards development work, and this generated a lot of discussion.

The final presentation of day 2, on "Content community and connectivity" was given as a double act between **Amreesh Modi, Navteq**, and **Bruno Simon, Connexis**. Navteq is a supplier of navigational technology and map data while Connexis co-developed the NGTP platform with BMW, which had been presented in the previous presentation. Both of these markets are being transformed by the challenge of Web 2.0, for instance, integrating mash-ups of map data with contextual information (see for instance Figure 17). There is also a requirement to reduce the latency in map updates and to increase response times. The Navteq/Connexis map updating system addresses this requirement.

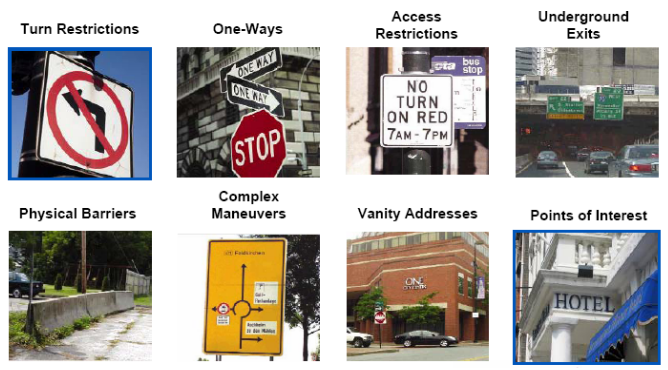


Figure 17: Contextual information that could be incorporated into navigation mapping systems
Source: Amsreesh Modi and Bruno Simon

Day 3: Friday March 7

Session 7: In-car platform and network devices

The first session of Day three was moderated by **Mr Michael Noblett, Connexis**, and the chair of ISO TC 204 as well as general chair of the2008 ITS World Congress. Upcoming ITS-related events include the World Congress (New York, November 2008) and the European Congress (Geneva, at Palexpo, 3-6 June

2008). He invited participants to submit suggestions for the future work of the ITU-T APSC TELEMOV group.

Figure 18: Trends in portable navigation devices
Source: Jim Bridgwater

Mr Jim Bridgwater, Freescale Semiconductor (USA), addressed, "The impact of fully-portable devices into the fully networked car". He began by explaining current trends in consumer markets for portable entertainment devices, which are driven by falling prices and increasing functionality. For instance, the cost per GB of flash memory storage has fallen from US$22.70 in 2006 to just US$5.60 in 2008. He also outlined trends in portable navigation devices (see Figure 18), where the main trend is the emergence of converged, high-featured devices. Similarly, in the mobile phone world, functionality continues to improve, with typical 2007 mobile phones having up to 3 Megapixel cameras, a processor above 600 MHz, a memory of 4GB plus and data rates of up to 3.6 Mbit/s. By 2011, mobile phone memories will typically be 160GB plus, with a 1-3 GHz processor and data rates of up to 100 Mbit/s; effectively a high-performance mobile computer. This will rolling out facilitate navigation functionality to cell phones. He argued that the role of the PC as the primary device for obtaining and managing content will therefore diminish over time. The implications for in-car infotainment therefore is to maximize access to content on portable devices rather than requiring specialized, fixed, in-car devices. It will also require more "i-Phone like" graphical user interfaces and a flexible infotainment architecture.

Mr Paul Goossens, Intel (USA) addressed the topic "In-vehicle infotainment". He argued that that iPod and the iPhone have revolutionized the portable infotainment industry and that this is now coming to the in-car environment, and more generally in nomadic applications. An important recent trend has been the coupling of navigation related to location-based services (for instance, if fuel is low, it might indicate the location of the nearest petrol station). Intel is involved in a number of ways, including providing Chipsets (for instance for mobile internet devices, or MIDS), promoting WiMAX as a means of delivering connectivity and developing LINUX as an open source operating system for in-car devices.

Mr. Frank Daems, NXP semiconductors (Netherlands), addressed the topic "Automotive telematics". Next-Experience Semiconductors (NXP) is a spin-off from Phillips. Automotive telematics might be defined as machine-to-machine applications based on cellular modem and satellite positioning. He described future trends in the sector, drawing upon the EU "First intelligent car report"[2], which is summarized in Figure 19. The aim is to focus initially on mobility, then improve safety and finally improve efficiency. He introduced the ATOP concept (Automotive Telematics On-board unit Platform), which is currently being developed by NXP and partners. ATOP will be an enabler in applications like e-Call and road pricing. He also emphasized the need for security in traffic messaging and mobility information services.

[2] European Commission (2007) "Towards Europe-wide safer, cleaner and more efficient mobility", available at: http://ec.europa.eu/information_society/activities/esafety/doc/i2010_intelligent_car/en_com_intelligent_car.pdf

	Now	2010	2012	2014	2016	2018
EU direction		MORE mobile		Safer		Efficient
Market	None	After market	Integrated in PND-phones	First OEM in car devices OEM		OEM
Service delivery	Proprietary and fragmented initiatives	Aggregated		Move towards open service delivery		
On-Board Unit (OBU)		Single scheme OBU	Multi scheme OBU Ecall added	Open information services	Integrated in car and communicating with in car sensors and actuators.	

Figure 19: A European vision towards the more intelligent car
Source: Frank Daems

Mr Pat Kennedy, Chairman, Cellport Systems (USA) argued that there is need for a paradigm shift in the way we view the delivery of in-car information, with a focus on the mobile phone as the universal connectivity device. Cellport has launched the Omniport platform for mobile phones in 2008. Omniport aims to provide Wi-Fi, Bluetooth and USB connectivity to connect multiple different mobile phone platforms, carriers and web services ("islands of disconnect") with proprietary car interfaces. The main challenge to overcome is the "walled garden" approach of proprietary systems and content. He provided detail on the current status of the Omniport platform.

Mr Alberto Los Santos, Telefónica I+D (Spain) presented further information on the MYCAREVENT programme. MYCAREVENT aims to provide a platform for garages, roadside assistance companies and drivers etc to access specific technical information from the main European vehicle OEMs. Many partners are involved and Telefónica role is the development of end-user applications. The main services developed are remote advice, location of nearest garages, information on their current workload and an interface for travel assistance companies. It is envisaged that MYCAREVENT would be available via embedded Car computers, a 2.5/3G Personal Digital Assistant (PDA) or a 3G mobile phone (see www.mycarevent.com). Being bundled with other applications is considered essential for their commercial viability.

Session 8: Voice and audiovisual services

Session 8 of the workshop, moderated by **Mr Hans W. Gierlich, HEAD Acoustics**, turned the focus on voice and audiovisual services.

Mr Harald Kohler, SMSC Europe GmbH (Germany), presented the "MOST150 – Next-generation automotive infotainment backbone". MOST 150 is the latest version of a series of backbone products for in-car

1979 S-Class*	1991 S-Class	1998 S-Class	2005 S-Class
1. Radio 2. Amplifier	1. Radio 2. Amplifier 3. CD 4. Telephone	1. Radio 2. Amplifier 3. CD 4. Telephone 5. Microphone 6. E-Call 7. Navigation	1. Radio 2. Amplifier 3. CD 4. Telephone 5. Microphone 6. E-Call 7. Navigation 8. PDA I/F 9. TV-Tuner 10. DVD 11. Displays 12. Headphones

Figure 20: Increasing range of in-car devices
Note: Based on generations of Daimler S-Class
Source: Harald Kohler

entertainment, and aimed at supporting the growing range of in-car devices which continue to grow (see the example of the Daimler car platform in Figure 20). The main new features of the MOST150 are optimization of control communication, extended audio support, seamless and cost-effective support for video and extended support for high-speed data transmission.

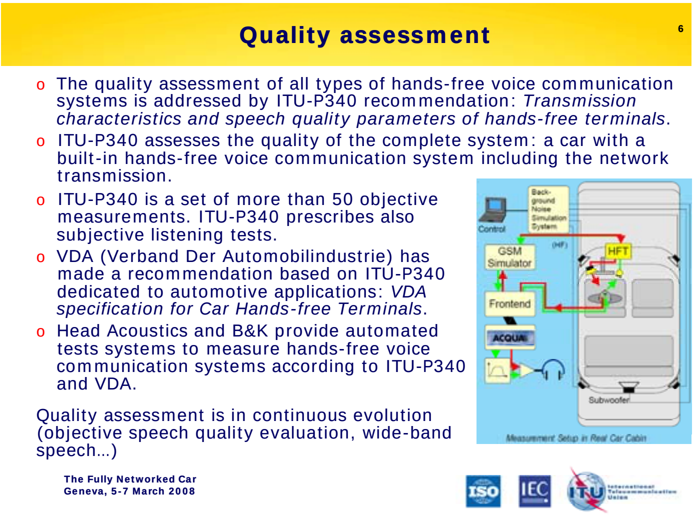


Figure 21: Quality assessment for hands-free communication devices
Source: Jean-Pierre Jallet

Mr Jean-Pierre Jallet, NXP Semiconductors (Netherlands) presented on "Multi-channel acoustic echo cancellation for in-car hands-free voice communication". Acoustic echo cancellation (AEC) is essential for any hands-free voice communication and, in the context of in-car use, AEC must also use noise reduction. ITU-T is involved in standardizing quality assessment in the field of hands-free communication and has issued ITU-T Recommendation P.340 on this topic (see Figure 21). In the future evolution of this Recommendation, the aim is to provide multi-channel, full-duplex, high-quality, wideband speech, and to support multi-microphone AEC. Furthermore, AEC must be able to support "barge-in" (i.e. non-sequential speech patterns) as well as improvement of in-car voice communication by using the car radio (so that back-seat passengers can hear those in the front-seat).

Mr Hans W. Gierlich, Head Acoustics, (Germany), presented the work of the ITU-T Focus Group FITCAR on ITU-T test specifications for hands-free terminal use in cars. Unlike Study Groups, Focus Groups are open to non-members and they are usually time-bound in their lifespan. FG FITCAR (From/in/to car communication) reports to ITU-T Study Group 12 and has as members representatives from the car industry, suppliers to the car industry, telecoms industry, universities and software companies. The main elements of the FG FITCAR specification are shown in Figure 22. Although mobile phones generally follow international standards, such as Bluetooth, in reality there is a high degree of variation in performance, which is why quality assessment and test interfaces are so important. FITCAR's work to date has been mainly concerned with narrowband communications, but with the creation of the new CARCOM Focus Group, which will have its first meeting on 12 June 2008 in Denmark; it will now work on a wideband specification.

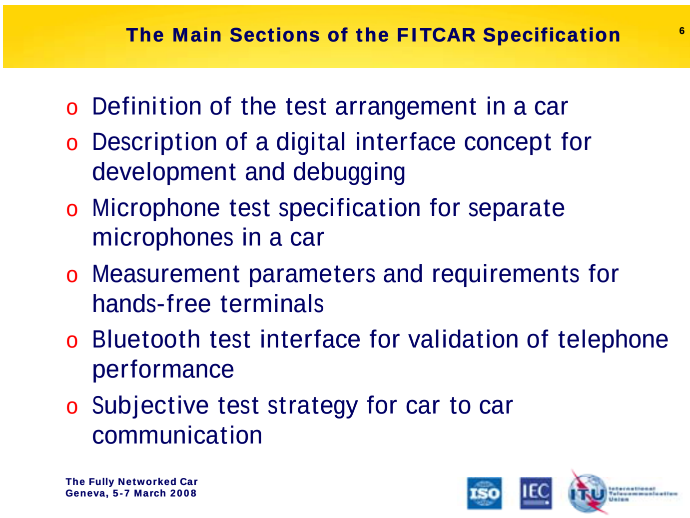


Figure 22: FITCAR specifications
Source: Hans W. Gierlich

Mr Gerhard Schmidt, Harman/Becker Automotive Systems (Germany) looked at "Recent trends for improving automotive speech enhancements". The boundary conditions for automotive speech enhancement are the owner of the car, the (few) people who regularly use the car and the likelihood of periods of high signal-to-noise ratio (SNR). The dimensions of in-car speech are illustrated in Figure 23. The techniques that can be used to enhance speech include artificial bandwidth extension, use of wideband rather than narrowband, noise suppression, voice reconstruction and adaptive equalization. His presentation contained a number of audio file samples to show the range of enhancements that could be offered.

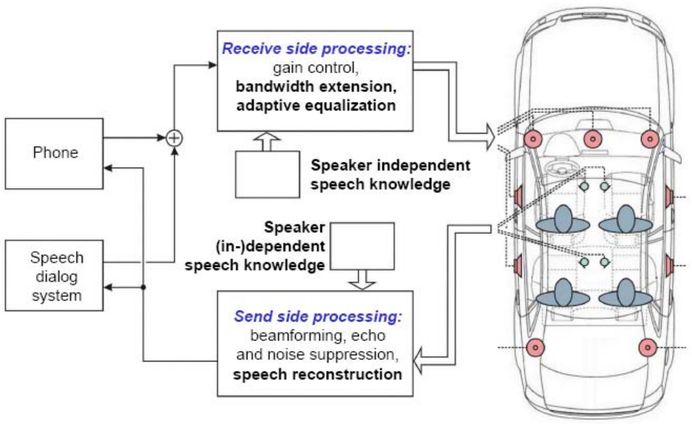


Figure 23: The dimensions of in-car speech enhancement
Source: Gerhard Schmidt

Prof. Dr Tim Fingscheidt, Braunschweig Technical University, presented on "Consistent improvement of speech quality by wideband speech technologies". Wideband speech might be defined as occupying a minimum of 16 kHz while narrowband is below 8 kHz. Furthermore, it offers a lower cut-off frequency (below 300 Hz) and a higher upper cutoff (above 3400 Hz). Using these techniques the "Mean Opinion Score" (MOS, ranges between 1 and 5) can be improved by 1.5 points. The better the speech quality, the less processing power of the driver's brain will be required for working out what is said, leaving more available for safe driving! ITU-T Recommendation G.722.2 (2001) defines the adaptive multi-rate wideband (AMR) speech codec. Again, the presentation contained a number of audio file systems to show the advantages that can be achieved through artificial bandwidth extension.

Mr Volker Jantzen, CEO SVOX (Switzerland) presented on "The importance of speech technology for the fully networked car". He presented the state-of-the art in the technology, as represented by BMW Talks for voice control, and the state of the art in current products as represented by Volkswagen RNS 510 for text to speech conversion (for in-car listening). In terms of developments in speech technology, the objectives are to increase safety, more efficient human-to-machine communication and to permit new dimensions of interaction (e.g., reading of emails while driving, by using speech to text conversion). The main problem is that humans are not used to using audio interfaces and often have had bad experiences in the past, for instance with poorly defined interfaces. Price also tends to be high. New possibilities include "one-shot destination input" allowing the user to say the complete address in one sentence without having to give separate inputs for the street, the city etc.

Session 9: Safety

The final session, moderated by **Mr Jean-Michel Henchoz, DENSO Automotive** (Germany), looked at road safety.

Mr Gregorio Martin, Telefónica I+D, examined the issue of "Resource allocation in dangerous good transportation environments", a particular concern of the European Union (see 2003-2010 European Road Safety programme. He outlined the GoodRoute research project, due for completion in 2008, which aims to develop a cooperative system for the transport of dangerous goods. There are three pilot sites in Italy, Switzerland and Finland. This presentation focused on the conflict resolution module (CRM) of GoodRoute. Conflicts arise when different dangerous goods vehicles (DGVs) require simultaneous routing through infrastructure, or exceed its maximum capacity. Conflicts may also arise where some roads are blocked or temporarily closed. The CRM approach uses a heuristic approach and a step-by-step methodology.

Mr Fulvio Sansone, Oracle EMEA (Italy) presented on the topic "An interoperable eCall end-to-end implementation based on service-oriented architecture and web services technology". Service-Oriented

Architecture (SOA) is a standards-based platform that lets application developers model, develop, find and combine services into flexible business processes. ECall is the European system for emergency calls. The general service set up is illustrated in Figure 24. The Oracle Telematics Foundation offers a solution for providing eCall over a SOA platform.

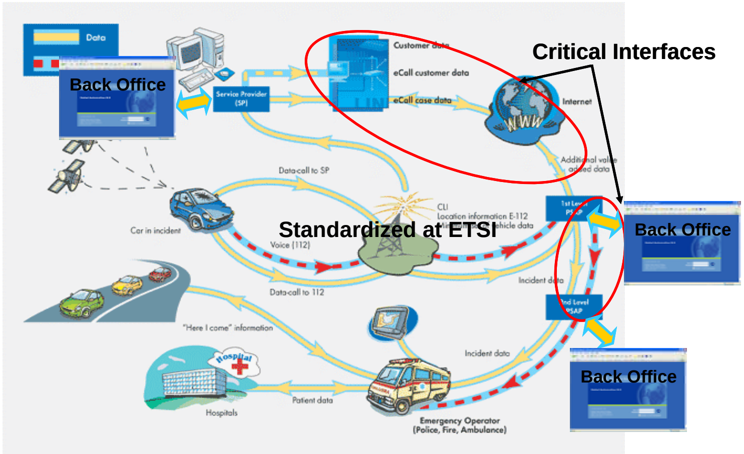


Figure 24: eCall service set-up
Source: Fulvio Salsone

Mr Rainer Makowitz, Freescale Semiconductor, reminded us that "The best road in-car safety device is a rear-view mirror with a cop in it"! His presentation, entitled "[driving towards a safer future]" focused on the component electronics in safety devices. Until 2006, road fatalities in the EU were decreasing, but in 2007 they grew, perhaps because of lower road safety among the newer members of the Union. To achieve the EU objectives set for 2010, however, it will be necessary to cut fatalities even further (see Figure 25). Examples of safety assistance include automatic braking systems (ABS), braking assistance, airbags etc. New work is focusing on the pre-crash situation, for instance with drowsiness monitoring, lane keep assist, blind spot detection etc. In addition, other safety systems, like night vision or parking assistance, are useful also in normal driving situations. In surround sensing, it is likely that camera-based systems will ultimately prevail rather than radar-based systems, as prices fall and processing power rises. For instance, camera sensing based on stereo vision will require between 1'000 – 5'000 million instructions per second (MIPS). Standards in this area include IFIP WG 10.4.

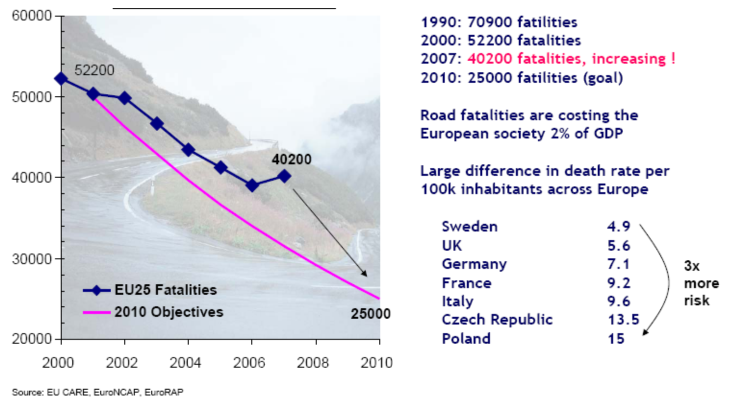


Figure 25: Trends in EU road fatalities
Source: Rainer Makowitz

Mr Robert Brignolo, FIAT (Italy), [presented the SAFESPOT integrated European safety project]. The SAFESPOT consortium involves 51 partners and is due to complete its work in January 2010. The SAFESPOT concept is to design cooperative systems for road safety based on V2V and V2R communications. It draws upon existing standards, including CALM and the Car-2-Car consortium. It uses relative positioning systems provided by satellite (Galileo), communications-based positioning (ultrawideband, wireless LAN) and image-based positioning (e.g., based on landmarks recognition). The enabling technology uses local dynamic maps. Five test sites have been defined with 2009 the target date for demonstrations. A number of

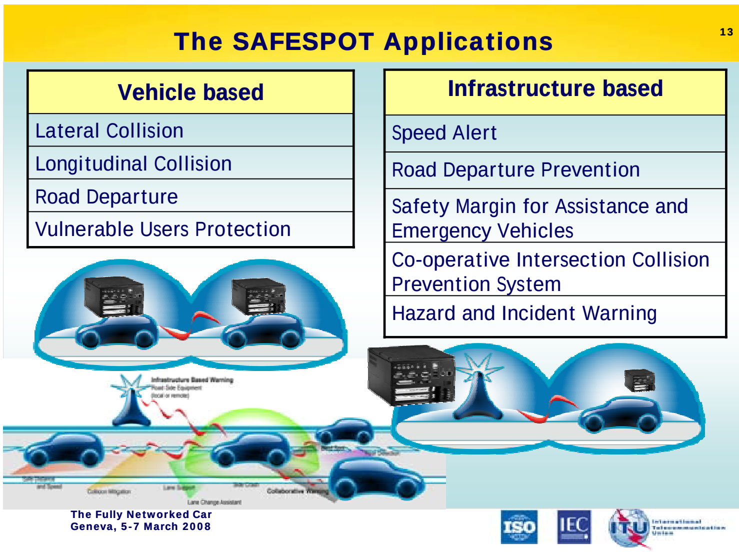


Figure 26: SAFESPOT applications
Source: Roberto Brignolo

safety-related applications are envisaged (see Figure 26). These are both vehicle-based and infrastructure-based, with the latter being easier to implement.

Mr Pierre Piver, WAVECOM, addressed the topic "eCall: an opportunity to bring standard connectivity to all cars by implementing a smart integration of the in-vehicle system". WAVECOM provides pre-packaged wireless communications solutions for automotive, industrial and mobile professional applications. The European roadmap envisages 2011 as the date by which eCall will be a standard option in all type approved vehicles. Thus far, 16 EU countries have signed the MoU, but those that have still to sign include UK and France. Key criteria for eCall are presented in Figure 27. Some unresolved issues include whether or not to include SIM (subscriber identification module) cards and how to reduce costs so that it can be installed in every car.

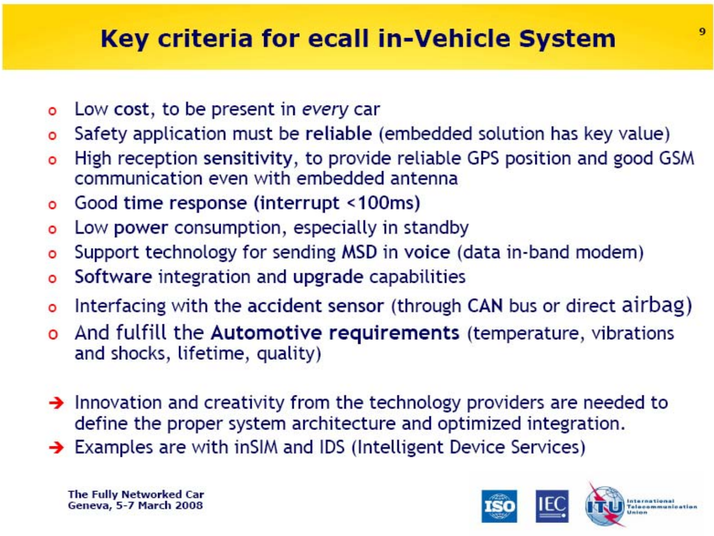


Figure 27: Key criteria for eCall
Source: Pierre Piver

Mr Pierre Papadimitriados, EPFL (Switzerland), gave the final presentation, on "Secure Vehicular Communications (SeVeCom)". Security is important because of the danger of the spread of deliberately false traffic information for malicious purposes (for instance, to avoid paying speeding fines). Also, privacy is important given the sensitivity of travel information (e.g., why were you in Paris last week?) Any security system requires some form of authentication, but that still does not present the transmission of false data. So there needs to be a system for real-time revocation of certificates once a faulty node is identified. One system for this is defined by the LEAVE (Local Eviction of Attackers by Voting Evaluators) protocol. It sets up a data-centric trust environment based on, for instance, the type of vehicle (police cars are more trusted that private cars), and the reinforcement of similar messages from multiple vehicles. The mathematics is complex, but this provides a fruitful potential area for standardization (see the results of the 20-21 February workshop on SeVeCom, held in Lausanne, EPFL).

Wrap-up and review session

Mr Reinhard Scholl, ITU-T, on behalf of the workshop organizers, presented briefly the summary slides for each of the different sessions. These are available on the website at: http://www.itu.int/dms_pub/itu-t/oth/06/10/T06100010010001PDFE.pdf. In addition, this meeting report will be posted for comments in the week beginning 10 March, together with photos from the different events. The draft press release is also online on the ITU-T newslog.

The fifth annual Fully Networked Car workshop will be held at Palexpo, Geneva, from 4-5 March 2009.

Glossary of abbreviations and acronyms used in the document

ABS	Automatic Braking System
ACC	Adaptive Cruise Control
AEC	Acoustic Echo Cancellation
AMI-C	Automotive Multimedia Interface Collaboration
AMR	Adaptive Multi-Rate
AODV	Ad-hoc On-demand Distance Vector
ASPC TELEMOV	Advisory Panel for Standards Cooperation on Telecommunications related to Motor Vehicles
ATOP	Automotive Telematics On-board unit Platform
AUTOSAR	Automotive Open System Architecture
C2C	Car-to-Car
CALM	Continuous Air interface for Long and Medium range communications
CARCOM	ITU-T Focus Group From/in/to car communication II
CPRI	Common Public Radio Interface
CRM	Conflict Resolution Module
CVIS	Cooperative Vehicle Infrastructure System
DGV	Dangerous Goods Vehicle
DLNA	Digital Living Network Alliance
DSRC	Dedicated Short Range Communications
EDA	Enhanced Driver Awareness
EEBL	Electronic Emergency Brake Lights
EETS	European Electronic Toll Service
ETRI	Electronic and Telecommunications Research Institute
ETSI	European Telecommunication Standardization Institute
F1	Formula One
FIA	Fédération Internationale de l'Automobile
FITCAR	ITU-T Focus Group From/in/to car communication
GB	Gigabyte
GHG	Greenhouse gas
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
ICTs	Information and Telecommunication Technologies
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IFIP	International Federation for Information Processing
IP	Internet Protocol
IPv6	Internet Protocol version 6
ISO	International Organization for Standardization
ITS	Intelligent Transport Systems and Services
ITU	International Telecommunication Union
ITU-R	ITU Radiocommunication sector
ITU-T	ITU Telecommunication standardization sector
LEAVE	Local Eviction of Attackers by Voting Evaluators
M-VCI	Modular Vehicle Communication Interface
MANET	Mobile Ad-hoc Network
MIC	Ministry of Internal Affairs and Communications
MIDS	Mobile Internet Devices
MIPS	Million instructions per second
MOS	Mean Opinion Score
MYCAREVENT	Mobility and Collaborative work in European Vehicle Emergency Networks
NEMO	Network Mobility
NGTP	Next Generation Telematics Protocol
OBSAI	Open Base Station Architecture Initiative

OEM	Original Equipment Manufacturer
OLSR	Optimized Link State Routing
OSGi	Open Services Gateway initiative
OSGi-VI	OSGi - Vehicle Interface
PDA	Personal Digital Assistant
SDR	Software Defined Radio
SeVeCom	Secure Vehicular Communications
SG	Study Group
SIM	Subscriber identification module
SISTER	Satellite communications In Support of Transport on European Roads
SNR	Signal-to-Noise Ratio
SOA	Service-Oriented Architecture
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TISA	Traveller Information Services Association
UN	United Nations
V2I	Vehicle-to-Infrastructure
V2R	Vehicle-to-Road
V2V	Vehicle-to-Vehicle
VANET	Vehicular Ad-hoc Network
VSC	Virtual Sub-Centre
WAVE	Wireless Access in a Vehicular Environment
WiMAX	Worldwide Interoperability for Microwave Access
WSC	World Standardization Collaboration