Elektrische Signalverarbeitung Dr. Fischer GmbH

ESF News

Issue 2010/1 **Intelligent Transport Systems (ITS)** February 2010

Editorial

Efficient, safe and secure transportation of humans and goods in all transport modes is a continuously increasing global challenge. In addition, comfortable mobile online-access to data and added-value services is a pre-requisite for deployment of technologies in vehicles, at the roadside and in the infrastructure. Since more than two decades efforts to develop real-time means in support of these requirements, being based on information and communication technology, are undertaken in all regions of the world.

Initial solutions developed under the title "**Road Transport and Traffic Telematics**" (RTTT) focused on isolated problems of transport and traffic management handled with dedicated and partly proprietary technologies. Interconnection of solutions was achieved in the infrastructure only, if possible at all.

Public cellular networks started to support the mobility needs of the users, but were still restricted to services provided in the infrastructure. Services were mapped to and optimized for specific standardized communication technologies, and needed to be replaced by new systems during lifetime of a car.

The basic set of communication standards based on the concept of **CALM** (Communications Access for Land Mobiles) developed in WG16 of ISO TC204 "**Intelligent Transport Systems**" are providing fully mobile networking with redundant and complementary communication technologies including legacy systems and future emerging designs. Abstracting from details of wireless access technologies and ITS applications, automatic mapping of services to communications, supporting both horizontal and vertical handover, becomes feasible with CALM. This concept of ad-hoc vehicle-to-vehicle communications and integration into a communication infrastructure was developed by experts from all regions, trying to harmonize the approaches in standardization at ISO, IEEE and other regional / national standards organizations.

Industry initiatives, large research activities and field trials supported this approach. Within the last years, draft CALM standards were successfully implemented and validated in the project **CVIS** funded by the Commission of the European Union. CVIS equipment also was used successfully in other EU projects, e.g. SAFESPOT and COOPERS. The **SISTER** project evaluated CALM technology on its own hardware platform.

The ***success-story of ITS*** started around **2001** at ISO TC204 WG16 [ISO-1] with the first CALM work items. From the very beginning, the intention was to achieve globally acceptable standards. Harmonization activities with regional standards bodies (e.g. IEEE) and industry activities (e.g. C2C-CC in Europe) caused significant delays for publication of standards. However it was worth, as now a set of around 30 CALM standards is published or will be published in 2010.

In **2004**, four German car manufacturers founded the Car-to-Car Communications Consortium (C2C-CC) aiming on ad-hoc communications between vehicles based on WiFi technology [IEEE-2].

End 2004 we had the first European conference on CALM with contributions from Japan and USA, held at castle Reisensburg in Germany.

In December **2007**, ETSI founded the technical committee TC ITS [ETSI-1], triggered by CALM experts. The intention was three-fold:

- convert CALM standards into European standards,
- use the expertise of the ETSI testing competence centre in order to develop abstract test suites with TTCN-3 for CALM,
- develop complementary ITS base-standards for specific European needs (currently limited to a basic set of applications defined by automobile industry).

In **2009**, CEN TC278 founded WG 16 on "cooperative systems", which is going to work jointly on ITS applications together with the also newly founded WG18 of ISO TC204.

End of 2009 we got a supporting framework, which will speed up the process towards procurement of ITS equipment and services:

- mandate 453 of the EC on ITS standardization [EC-1],
- EU-US joint declaration of intent on research cooperation in cooperative systems [EC-2].

Dr. Hans-Joachim Fischer
Managing Director ESF GmbH

CVIS and other EU projects

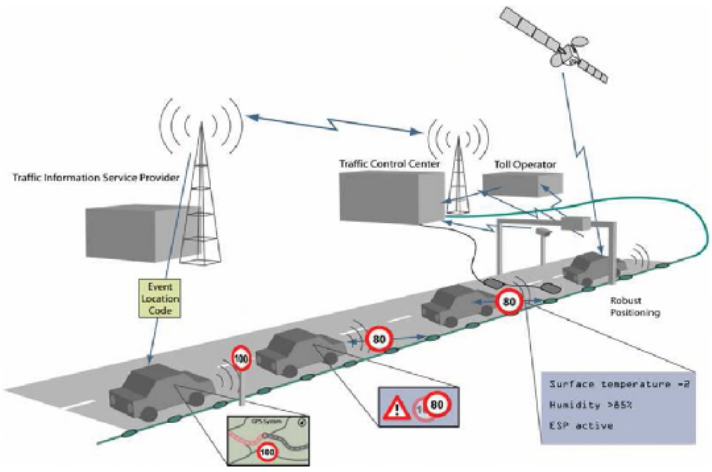
CVIS (Cooperative Vehicle-Infrastructure Systems) - http://cvisproject.org/ - designed, developed and tested the technologies needed to allow cars to communicate with each other and with the nearby roadside infrastructure. It is based on the set of CALM standards.

The project's ambition was to begin a revolution in mobility for travellers and goods, completely re-engineering how drivers, their vehicles, the goods they carry and the transport infrastructure interact.

CVIS realized an ITS platform in hardware and software being available also for other research projects. Main communication technologies used are cellular networks (ISO 21212/21213), IR (ISO 21214) and 5 GHz (ISO 21215) - combined with CEN DSRC for road-tolling. The platform consists of a router-box and a host-box, which now can be considered as "the ITS platform" for Europe. ITS applications considered in CVIS were "Monitoring and routing of dangerous goods", "Booking of parking zones", "Access control", "Cooperative traveller assistance", "Enhanced driver awareness", "Subscription to traffic information", "Traffic light priority service", "Speed profile application", "Cooperative traffic control", "Flexible bus lane", "Network assessment", "Routing application", "Strategy application" and "Traffic control assessment".

To validate the project's results, all CVIS technologies and applications were tested at test sites in seven European countries: France, Germany, Italy, Netherlands, Belgium, Sweden and the UK.

COOPERS (COOPerativeSystEms for Intelligent Road Safety) - http://coopers-ip.eu/ - focuses on the development of innovative telematics applications on the road infrastructure with the long term goal of a "Cooperative Traffic Management" between vehicle and infrastructure, to reduce the self opening gap of the development of telematics applications between car industry and infrastructure operators.



The goal of the project is the enhancement of road safety by direct and up to date traffic information communication between infrastructure and motorised vehicles on a motorway section.

The validation and test drives were performed on public motorway sections in France, Belgium, Netherlands, Germany (Berlin and Bavaria), Austria and Italy.

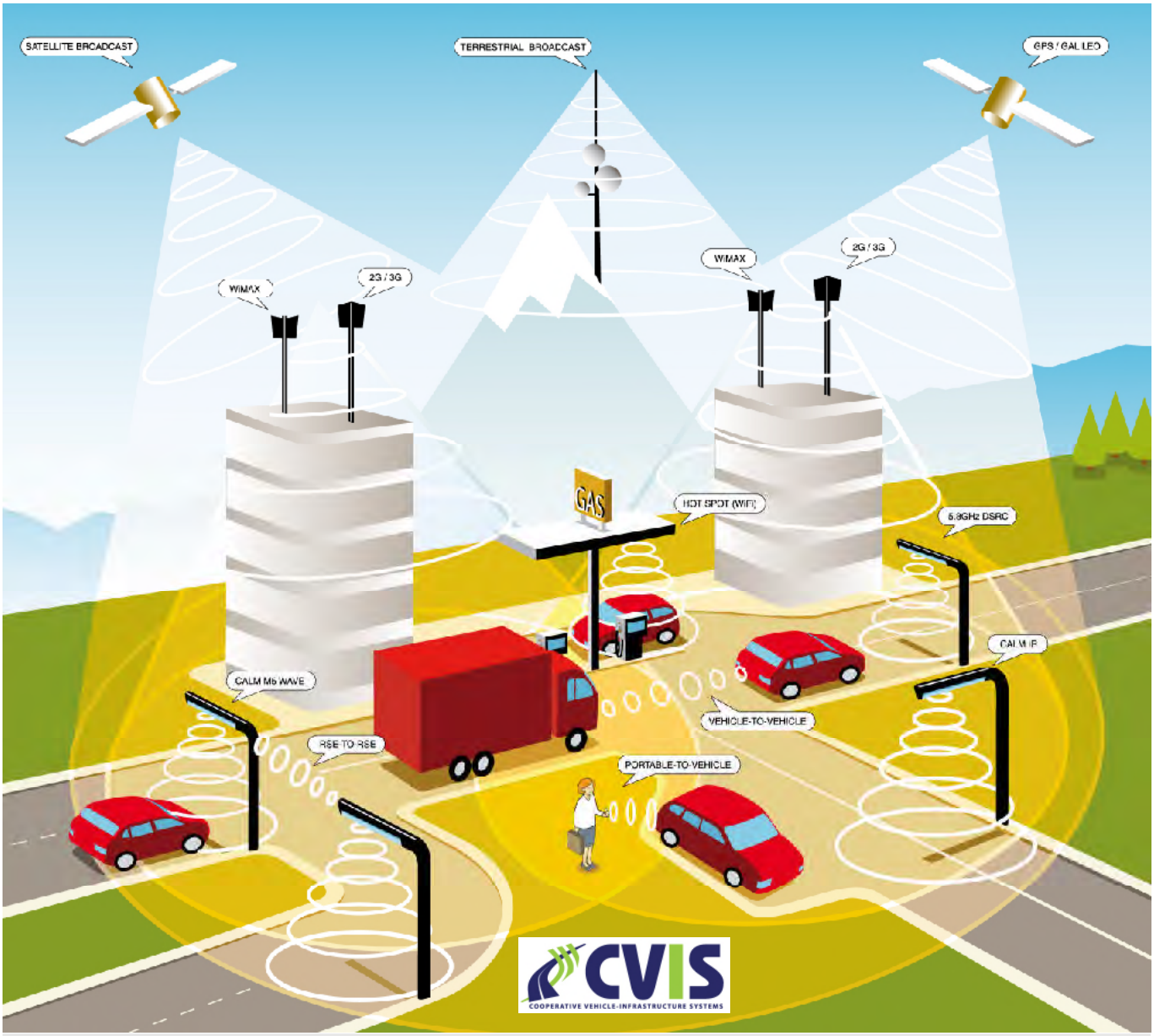
SAFESPOT - http://safespot-eu.org/ - aims on understanding how intelligent vehicles and intelligent roads can cooperate to produce a breakthrough for road safety.

SAFESPOT applications and technologies will be validated in Test Sites located in France, Germany, Italy, Netherland, Spain and Sweden.

SISTER - http://sister-project.org/ - aims to promote the integration of satellite and terrestrial communications with GALILEO to enable mass market take-up by road transport applications. SISTER demonstrated how satellite communications can be used as part of the operational implementation of ITS applications, and how the operation of satellites affects the operation of such services. The project was build on and complemented the large volume of work already performed in this field in European Space Agency (ESA), EU and GALILEO Joint Undertaking (GJU) projects.

SeVeCom (Secure Vehicular Communication) - http://sevecom.org/ - addresses security of the future vehicle communication networks, including both the security and privacy of vehicle-to-vehicle communication and of the vehicle-to-infrastructure communication. Its objective is to define the security architecture of such networks, as well as to propose a roadmap for integration of security functions in these networks.

GeoNet - http://geonet-project.eu/ - is combining GeoNetworking and IPv6 into a single communication architecture, which is referred to as IPv6 GeoNetworking. This will open the door for the development of new ITS applications that require data to be transmitted to explicit geographical areas. GeoNet specified, implemented and validated the necessary functional blocks The GeoNet functionality fits to the ITS architecture and will be standardized at ISO TC204 WG16.



EC mandate 453 on ITS

On 6th October 2009, EC DG ENTR/D4 published the standardisation mandate M/453 addressed to CEN, CENELEC and ETSI in the field of Information and Communication Technologies (ICT) to support the interoperability of Co-operative systems for Intelligent Transport in the European Community.

> The work programme should also take into account the world wide coordination of standardisation activity for the Co-operative ITS services and include European standardisation activities in support of the world wide standardisation achievements.

Whilst CENELC will not work on this topic, ETSI TC ITS and CEN TC278 WG16 currently develop the requested work plan in response of the mandate.

ETSI so far is focusing on a basic set of applications and related communication technology for road safety applications, CEN has a much broader scope of cooperative systems and a more global view.TC278 WG16 is jointly developing global standards for cooperative applications with ISO TC204 WG18. Communications for cooperative systems is standardized at ISO TC204 WG16. A basic set of CALM (Communications Access for Land Mobiles) standards already is finalized. The EU research project implemented and validated CALM standards. In a second phase, the CALM experts will

- editorially harmonize the set of simultaneously developed standards,
- improve further and complement these standards with respect of the EU-U.S. Joint Declaration of Intent on Research Cooperation in Cooperative Systems, taking into account the results of EU projects, e.g. CVIS, GeoNet, SAFESPOT.

> • Results of relevant EU Research projects should be considered in the standardisation work.

The set of CALM standards is based on the ITS architecture as specified in [ISO-2].

Paradigm of the ITS station

An ITS station (ITS-S) is a logical or physical entity in a communication network, comprised of applications, facilities, networking & transport and access layer components presented in figure 1, that operate within a bounded secure management domain [ISO-2].

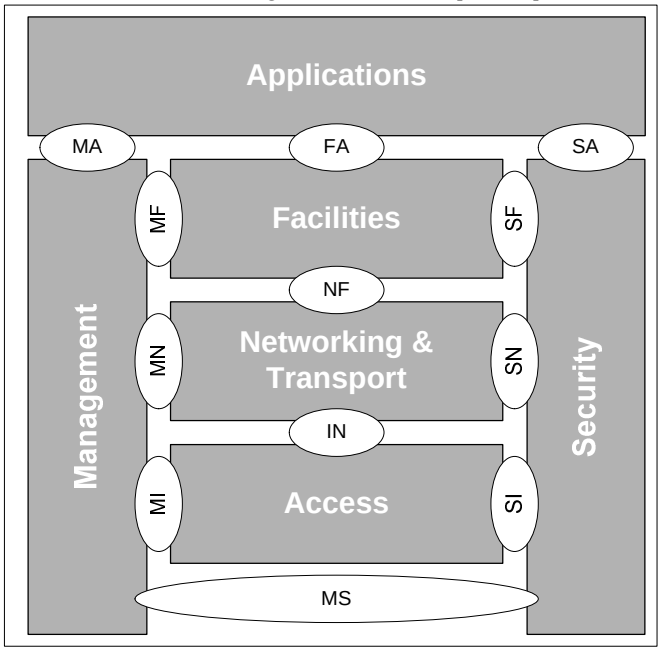


Figure 1: ITS station reference architecture

In figure 1, the blocks "Access", "Networking & Transport" and "Facilities" provide the functionality of layers one and two, three and four, and five to seven, respectively, of the OSI communication protocol stack.

The block "Management" contains the ITS-S management. The block "Security" can be considered as part of the ITS-S management and contains functionalities to support secure operation.

The block "Applications" contains ITS-S applications.

These blocks are interconnected either via observable and testable interfaces or via service access points according to the OSI model.

ITS sub-systems

Four basically different ITS sub-systems are distinguished according to the context of installation as presented in figure 2. Each ITS sub-system contains an ITS station.

A vehicle ITS station may connect via a vehicle gateway to actors and sensors in the vehicle. Vehicle-to-vehicle communications constitutes ITS ad-hoc networking presented in figure 3. This also includes forwarding of packets by roadside stations, and local communications between vehicles and roadside stations.

A roadside ITS station may connect via a roadside gateway to actors and sensors in the roadside, and may connect via a border router to public and private networks and the global Internet. Vehicle-to-roadside communications constitutes ITS access networking pre-

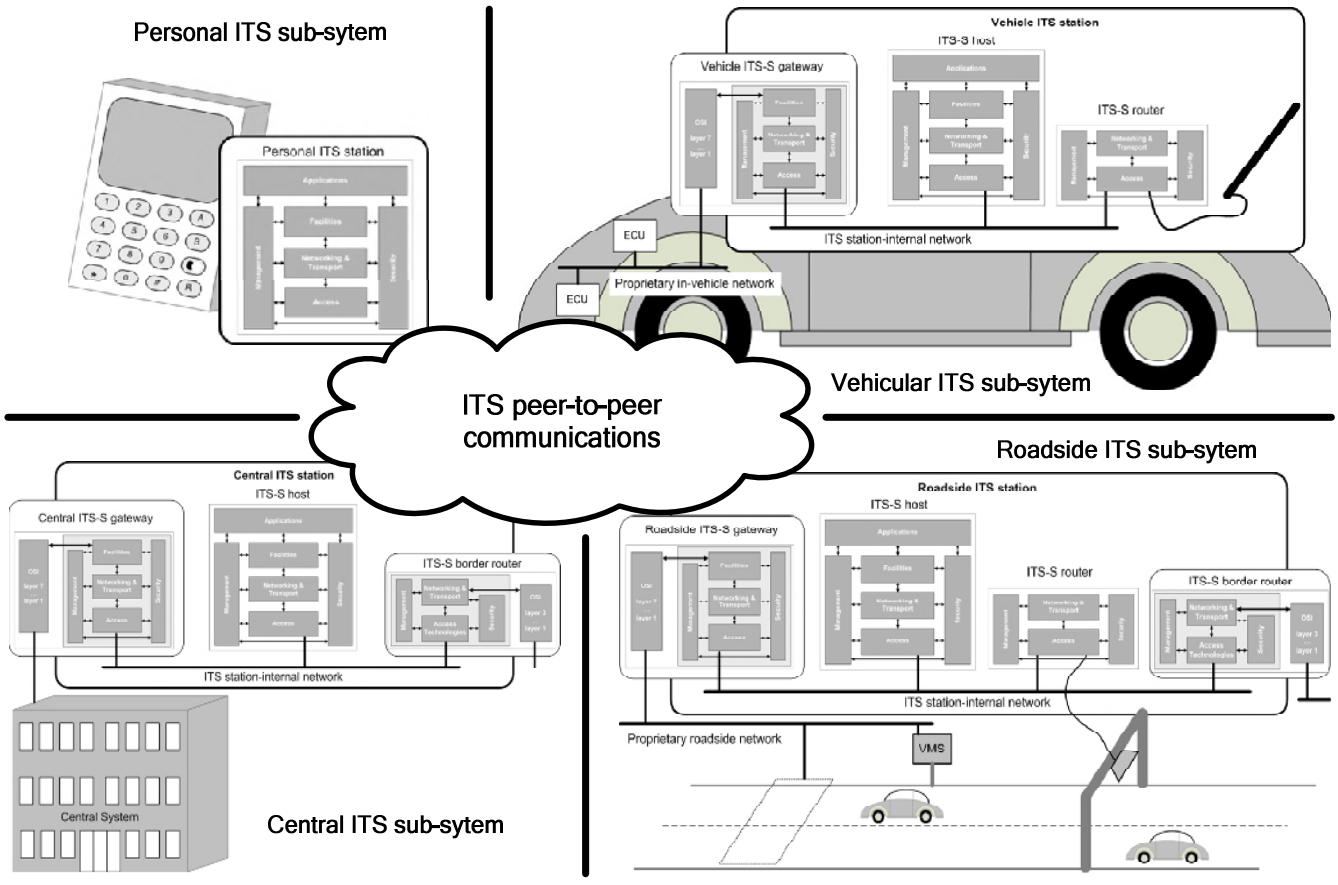


Figure 2: ITS sub-systems

sented in figure 3. This may also include ITS communications between roadside ITS stations.

A central ITS station may connect via a central gateway to the central station, and may connect via a border router to public and private networks and the global Internet, see the generic domain in figure 3.

A personal ITS station is a hand-held device. It may also become an integral part of another ITS station, e.g. acting as a user interface inside a vehicle.

Networking

Figure 3 presents the top-level view of networking in ITS.

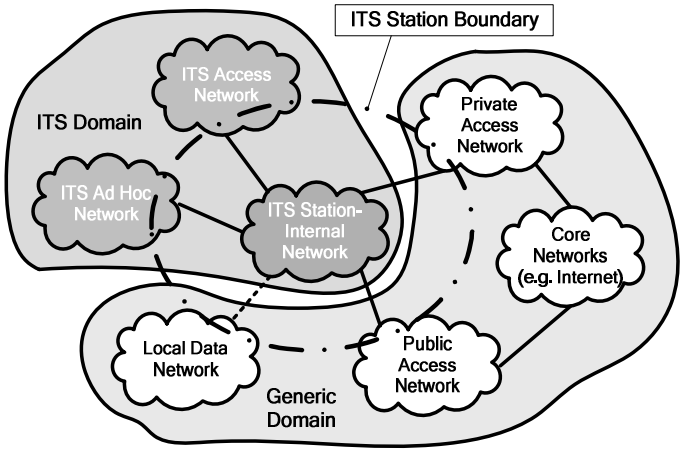


Figure 3: Top-level view of networking in ITS

The ITS station boundary is indicated with a dashed line. Two domains are distinguished:

- The generic domain contains gateways, private and public access networks and core networks. Internal details of the generic domain are outside the responsibility of ITS standards.
- The ITS domain contains ITS ad-hoc networks, ITS access networks in order to interconnect different ITS stations, and ITS station-internal networks in order to interconnect different units in an ITS station.

Paradigm of abstraction

A core element of CALM, which makes it to be a significant milestone in mobile communications, is the paradigm of abstraction. Abstractions allow to handle mapping of ITS-S applications on communication interfaces, i.e. the automatic selection of an "ITS Communication Channel" as illustrated in figure 4.

Applications are abstracted by means of properties, e.g.

- priority - classes and individual values,
- ownership,
- application area,

and communication needs, e.g.

- communication bandwidth,
- latency,
- type of communication - streaming data or packets,
- cost,
- reliability,
- access technology [ISO-6 - ISO-9, and others] - for mandatory applications in specific regulatory domains,
- type of networking [ISO-4, ISO-5].

Communication interfaces are abstracted by means of properties, e.g.

- access technology - IR, M5, cellular technologies
- frequency,
- data rate,
- capability to access Internet,
- cost,
- access restrictions (priority and ownership of ITS-S applications).

Based on rules and policies, functional requirements from ITS-S applications, and static and dynamic properties of communication interfaces, ITS communication channels are assigned to ITS-S applications as presented in figure 4 [ISO-3]. An ITS communication channel is defined by a mapping of an ITS-S application via a selected networking & transport layer protocol to the best suited communication interface. Some of these mappings may be static in a given regulatory domain, others will be highly dynamic, making best use of redundant and complementary access technologies by means of horizontal and vertical handover procedures, which also is considered to be an important part of distributed congestion control.

This management core is the "backbone" of CALM. It allows serving existing and future technologies in all OSI layers and in the security entity.

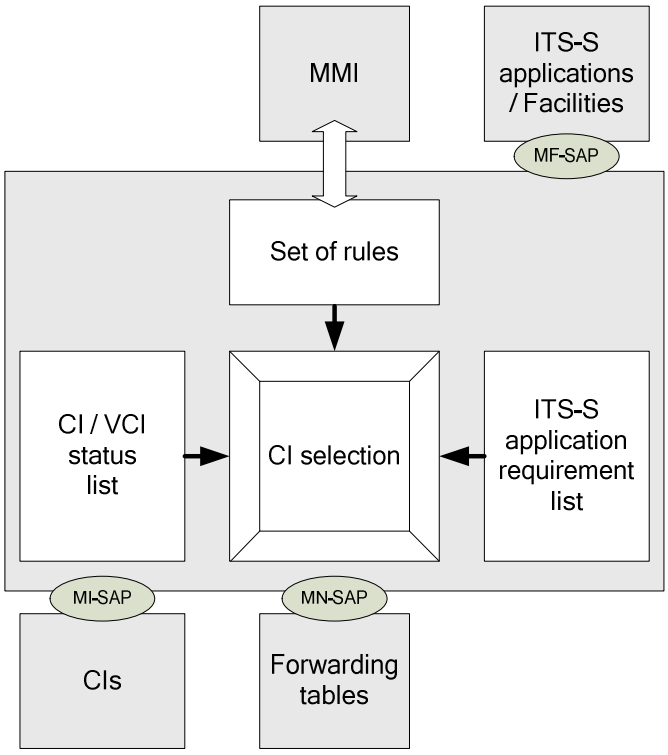


Figure 4: Communication channel selection

ITS services and applications

Different to RTTT, applications in ITS, e.g. road safety, traffic information and management, video downloads to mobile stations for tourist information and entertainment

and navigation-system-updates, have more demanding requirements in terms of communication distance and bandwidth, and in availability of the communication services.

ITS applications provide ITS services to the users and are associations of ITS-S applications (e.g. server and client), which interact with each other by using ITS-S services, i.e. communications [ISO-2].

CALM-aware ITS-S applications implement ITS-S application specific functionality with the capability to control the interaction with the CALM environment. However non-CALM-aware ITS-S applications (legacy applications) also are supported in a default communication mode.

Management and security

Important elements of the CALM communication and station management [ISO-3] are e.g.:

- distributed congestion control for an individual access technology, but also making use of handover between different access technologies,
- interference management,
- CALM FAST service advertisement, which is similar to WAVE and CEN DSRC, but supporting larger communication zones,
- ITS communication channel selection as presented above,
- local node map handling, also referred to as "radar view handling", which is an essential capability in the context of geo-routing,
- station-internal management communications, supporting distributed implementations of an ITS station in several physical boxes in a standardized way,
- management information base (MIB)

ITS security partly is end-to-end security under the responsibility of ITS applications, and partly is integrated into the communication protocol stack. Security mainly is still under basic development in several SDOs.

EU-US joint declaration of intent on research cooperation in cooperative systems

Dated 13 November 2009, Mr. Zoran Stanči, Deputy Director-General from EC/DGINFSO, and Mr. Peter H. Appel, Administrator from USDOT/RITS signed the "EU-U.S. Joint Declaration of Intent on Research cooperation in Cooperative Systems".

Paragraph (10) of this declaration, shown below, refers to global standardisation. For ITS, the global standards maker is the International Standards Organization (ISO). TC 204 of ISO is dedicated to "Intelligent Transport Systems". Work on ITS communications for cooperative systems is conducted in WG16 of TC204. This WG16 of TC204 cooperates with regional standards organisations, e.g. IEEE in USA and ETSI in Europe. Cooperative applications are being jointly standardized at ISO TC204 WG18 and CEN TC278 WG16. ISO TC204 WG16 has finalized the basic set of CALM (Communications Access for Land Mobiles) standards, of which the last standards will be published in 2010. From the very beginning, TC204 WG16 has a still continued intensive cooperation with IEEE 802, mainly with TGp on "5,9 GHz ad-hoc communication)".

The joint declaration of intent will push finalization of harmonized and globally applicable ITS standards for cooperative systems in order to achieve early deployment and global interoperability. In Europe, this si supported by the EU mandate M/453 on ITS standardisation - see also in these news.

The definition of cooperative systems, as given by CEN TC278 WG16 is: ""A cooperative ITS is a subset of the overall ITS that

- communicates and
- shares information

between ITS stations to

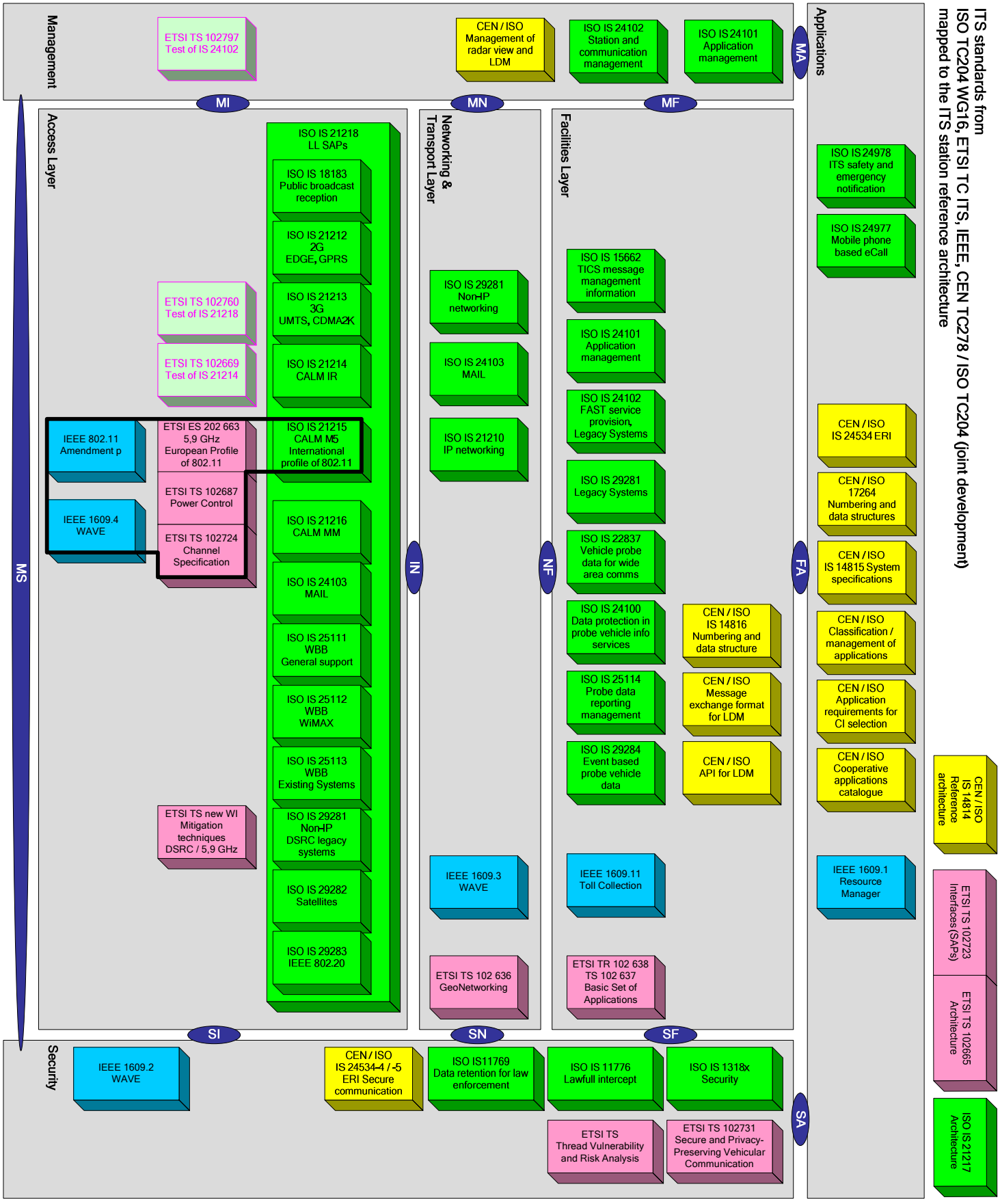
- give advice or
- take / enable expected actions

with the objective of improving

- comfort, sustainability, efficiency and safety

beyond the scope of stand-alone ITS"

(10) Globally harmonised standards are essential to support and accelerate the deployment and adoption of Cooperative Systems. The parties strongly support development of global open standards which ensure interoperability through appropriate actions including, but not limited to, coordinating the activities of the standardisation organisations. In particular, the parties intend to make efforts to preclude the development and adoption of redundant standards. The adoption of multiple standards within a given area of interest should be limited to those cases where there are demonstrated technical needs, such as differing frequency spectrum allocations, and legal requirements, such as privacy protection laws. The parties welcome the participation of other countries and regions, particularly those of the Asia Pacific region, in the development of global open, harmonised standards for Cooperative Systems.



The figure shows a snap-shot made in 2009.

References

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Involvement of ESF GmbH

ESF GmbH is an independent standards developer working on RTTT and ITS since almost two decades.

In RTTT, Dr. Fischer contributed to the introduction of road tolling in Europe based on CEN DSRC and GNSS/CN.

Dr. Fischer is convenor of ISO TC204 SWG16.1, vice-chairman of ETSI TC ITS WG2, WG3 and WG4, Liaison officer between ETSI TC ITS and ISO TC204 WG16, member of CEN TC278 WG16, DIN GK 7171. ESF GmbH is full member of ETSI. Dr. Fischer is editor of ISO 21215, 21217, 21218, 24102, 29281, TS 102 665, TS 102 707, TS 102 723, TS 102 760. He was co-editor of ISO 21214 and others. He was chairman of ETSI STF 365. He was member of STF 372 and others. He is member of STF 398 on "ITS testing framework".

Imprint

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