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**Inteligentni transportni sistemi (ITS) - Preskušanje - Okvir za skladnost in preskušanje medobratovalnosti**

Intelligent Transport Systems (ITS) - Testing - Framework for conformance and interoperability testing

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# ETSI EG 202 798 V1.1.1 (2011-01)

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*ETSI Guide*

## **Intelligent Transport Systems (ITS); Testing; Framework for conformance and interoperability testing**

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## Reference

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## Keywords

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ITS, testing, conformance, interoperability**ETSI**

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## Foreword

This ETSI Guide (EG) has been produced by ETSI Technical Committee Intelligent Transport System (ITS).

The present document assumes that the reader has basic knowledge in testing as presented e.g. in [i.4], [i.7].

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## Introduction

"Intelligent Transport Systems" (ITS) are systems to support transportation of goods and humans with information and communication technologies in order to efficiently and safely use the transport infrastructure and transport means (cars, trains, planes, ships). With a focus on road transportation, elements of ITS for global applications are standardized in various standardisation organisations, both on an international level at e.g. ISO TC204, and on regional levels, e.g. in Europe at ETSI TC ITS and at CEN TC278 [i.13], [i.22].

The importance of ITS for the regional and the international market is expressed by the large number of activities of stake-holders, within regional research projects, industry initiatives and regional and international standardisation.

In Europe, the urgent need for ITS standards and the related test standards is expressed by the new mandate M/453 of the Commission of the European Union [i.36].

Mandate M/453 [i.36] also is given in the context of international harmonisation, as expressed by the EU-US joint declaration of intent on research cooperation in cooperative systems [i.35].

ETSI is prepared to take over a leading role in this process towards harmonized ITS. A major effort is on conformance and interoperability testing, which is being prepared by the present document on "ITS testing framework". The protocol conformance and interoperability testing framework is essential for a systematic and consistent approach towards testing of globally applicable ITS communications equipment.

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## 1 Scope

The scope of the present document is to support ITS projects on the development of test specifications for ITS base standards from ETSI, ISO, CEN and other "Standard Developing Organisations" (SDOs) by providing:

- An ITS testing framework for conformance testing.
- An ITS testing framework for interoperability testing.

The testing framework proposed in the present document provides guidance for development of conformance and interoperability test strategies, test systems and the resulting test specifications for ITS.

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## 2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

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### 2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] ETSI ETR 266: "Methods for Testing and Specification (MTS); Test Purpose style guide".
- [i.2] ETSI ETS 300 406: "Methods for Testing and Specification (MTS); Protocol and profile conformance testing specifications; Standardization methodology".
- [i.3] ETSI EG 201 058: "Methods for Testing and Specification (MTS); Implementation Conformance Statement (ICS) proforma style guide".
- [i.4] ETSI ES 201 873 (all parts): "Methods for Testing and Specification (MTS); The Testing and Test Control Notation version 3".
- [i.5] ETSI EG 202 237: "Methods for Testing and Specification (MTS); Internet Protocol Testing (IPT); Generic approach to interoperability testing".
- [i.6] ETSI EG 202 810: "Methods for Testing and Specification (MTS); Automated Interoperability Testing; Methodology and Framework".
- [i.7] ISO/IEC 9646 (all parts): "Information technology - Open Systems Interconnection - Conformance testing methodology and framework".
- [i.8] ISO 10746 (all parts): "Information technology - Open Distributed Processing - Reference model".
- [i.9] ISO 21210: "Intelligent transport systems - Communications Access for land Mobiles (CALM) - Non-IP networking".



- [i.10] ISO 21213: "Intelligent transport systems - Communications Access for Land Mobiles (CALM) - 3 G".
- [i.11] ISO 21214: "Intelligent transport systems - Communications Access for Land Mobiles (CALM) - IR".
- [i.12] ISO 21215: "Intelligent transport systems - Communications Access for Land Mobiles (CALM) - M5".
- [i.13] ISO 21217: "Intelligent transport systems - Communications Access for Land Mobiles (CALM) - Architecture".
- [i.14] ISO 21218: "Intelligent transport systems - Communications Access for Land Mobiles (CALM) - Medium Service Access Points".
- [i.15] ISO 24102: "Intelligent Transport Systems - Communications Access for Land Mobiles (CALM) - ITS station management".
- [i.16] ISO 29281: "Intelligent transport systems - Communications Access for Land Mobiles (CALM) - Non-IP networking".
- [i.17] ETSI TS 102 636: "Intelligent Transportation System (ITS); Vehicular communications; GeoNetworking".
- [i.18] ETSI TS 102 637 (all parts): "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; multiple parts".
- [i.19] ETSI TS 102 687: "Intelligent Transport Systems (ITS); Transmitter Power Control Mechanism for Intelligent Transport Systems operating in the 5 GHz range".
- [i.20] ETSI TS 102 724: "Intelligent Transport Systems (ITS); Harmonized Channel Specifications for Intelligent Transport Systems operating in the 5 GHz frequency band".
- [i.21] ETSI TS 102 860: "Intelligent Transport Systems (ITS); Classification and management of applications".
- [i.22] ETSI EN 302 665: "Intelligent Transport Systems (ITS); Communications Architecture".
- [i.23] ETSI TS 102 760-2: "Intelligent Transport Systems (ITS); Test specifications for Intelligent Transport Systems; Communications Access for Land Mobiles (CALM); Medium Service Access Points (ISO 21218); Part 2: Test Suite Structure and Test Purposes (TSS&TP)".
- [i.24] ETSI TS 102 797-2: "Intelligent Transport Systems (ITS); Road Transport and Traffic Telematics (RTTT); Test specifications for Intelligent Transport Systems, Communications Access for Land Mobiles (CALM), Interface Manager (ISO 24102); Part 2: Test Suite Structure and Test Purposes (TSS & TP)".
- [i.25] ETSI TS 102 859-2: "Intelligent Transport Systems (ITS); Testing; Conformance test specifications for Transmission of IP packets over GeoNetworking; Part 2: Test Suite Structure and Test Purposes (TSS&TP)".
- [i.26] ETSI TS 102 868-2: "Intelligent Transport System (ITS); Testing; Conformance test specification for Co-operative Awareness Messages (CAM); Part 2: Test Suite Structure and Test Purposes (TSS&TP)".
- [i.27] ETSI TS 102 869-2: "Intelligent Transport System (ITS); Testing; Conformance test specification for Decentralized environmental Notification Messages (DNM); Part 2: Test Suite Structure and Test Purposes (TSS&TP)".
- [i.28] ETSI TS 102 870-2: "Intelligent Transport Systems (ITS); Testing; Conformance test specifications for GeoNetworking Basic Transport Protocol (BTP); Part 2: Test Suite Structure and Test Purposes (TSS&TP)".
- [i.29] ETSI TS 102 871-2: "Intelligent Transport Systems (ITS); Testing; Conformance test specifications for GeoNetworking ITS-G5; Part 2: Test Suite Structure and Test Purposes (TSS&TP)".

- [i.30] ETSI TS 102 981-2: "Intelligent Transport Systems; Test specifications for Intelligent Transport Systems; Communications Access for Land Mobiles (CALM); IP networking (ISO 21210); Part 2: Test Suite Structure and Test Purposes (TSS&TP)".
- [i.31] ETSI TS 102 982-2: "Intelligent Transport Systems; Test specifications for Intelligent Transport Systems; Communications Access for Land Mobiles (CALM); IR (ISO 21214); Part 2: Test Suite Structure and Test Purposes (TSS&TP)".
- [i.32] ETSI TS 102 983-2: "Intelligent Transport Systems; Test specifications for Intelligent Transport Systems; Communications Access for Land Mobiles (CALM); M5 (ISO 21215); Part 2: Test Suite Structure and Test Purposes (TSS&TP)".
- [i.33] ETSI TS 102 984-2: "Intelligent Transport Systems; Test specifications for Intelligent Transport Systems; Communications Access for Land Mobiles (CALM); Architecture (ISO 21217); Part 2: Test Suite Structure and Test Purposes (TSS&TP)".
- [i.34] ETSI TS 102 985-2: "Intelligent Transport Systems; Test specifications for Intelligent Transport Systems; Communications Access for Land Mobiles (CALM); Non-IP networking (ISO 29281); Part 2: Test Suite Structure and Test Purposes (TSS&TP)".
- [i.35] EU-US Joint Declaration of Intent on Research Cooperation in Cooperative Systems, Washington, D.C., EC/DGINFSO and USDOT/RITA, November 2009.

NOTE: Available at:

[http://ec.europa.eu/information\\_society/activities/esafety/doc/library/us/joint\\_decl\\_on\\_coop\\_systems.pdf](http://ec.europa.eu/information_society/activities/esafety/doc/library/us/joint_decl_on_coop_systems.pdf).

- [i.36] Standardisation mandate addressed to CEN, CENELEC and ETSI in the field of information and communication technologies to support the interoperability of co-operative systems for intelligent transport in the european community, M/453, October 2009.

NOTE: Available at: [http://ec.europa.eu/enterprise/sectors/ict/files/standardisation\\_mandate\\_en.pdf](http://ec.europa.eu/enterprise/sectors/ict/files/standardisation_mandate_en.pdf).

- [i.37] ISO 16445: "Intelligent Transport Systems - Communications access for land mobiles (CALM) - Handover mechanisms".
- [i.38] IEEE 802.11: "Telecommunications and information exchange between systems - Local and metropolitan area networks-Specific requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications".
- [i.39] ISO 16444: "Intelligent Transport Systems - Communications access for land mobiles (CALM) - Geo-routing".
- [i.40] ISO 16440: "Intelligent Transport Systems - Communications access for land mobiles (CALM) - WAVE".
- [i.41] ISO 16460: "Wave Intergration".
- [i.42] ISO IS 24978: "Intelligent transport systems - ITS Safety and emergency messages using any available wireless media - Data registry procedures".
- [i.43] ISO IS 15662: "Intelligent transport systems - Wide area communication - Protocol management information".
- [i.44] ISO IS 24101 (all parts): "Intelligent transport systems - Communications access for land mobiles (CALM) - Application management".
- [i.45] ISO IS 24103: "Intelligent transport systems - Communications access for land mobiles (CALM) - Media adapted interface layer (MAIL)".
- [i.46] ISO IS 25112: "Intelligent transport systems - Communications access for land mobiles (CALM) - Mobile wireless broadband using IEEE 802.16".
- [i.47] ISO IS 29282: "Intelligent transport systems - Communications access for land mobiles (CALM) - Applications using satellite networks".

- [i.48] ISO IS 21216: "Intelligent transport systems - Wireless communications - CALM using millimetre communications".
- [i.49] ISO IS 21212: "Intelligent transport systems - Communications access for land mobiles (CALM) - 2G Cellular systems".
- [i.50] ISO IS 11776: "Light gauge metal containers - Non-round open-top cans - Cans defined by their nominal capacities".
- [i.51] ISO IS 25111: "Intelligent transport systems - Communications access for land mobiles (CALM) - General requirements for using public networks".
- [i.52] ISO IS 21213: "Intelligent transport systems - Communications access for land mobiles (CALM) - 3G Cellular systems".
- [i.53] ISO IS 29283: "ITS CALM Mobile Wireless Broadband applications using Communications in accordance with IEEE 802.20".
- [i.54] ISO IS 25113: "Intelligent transport systems - Communications access for land mobiles (CALM) - Mobile wireless broadband using HC-SDMA".
- [i.55] ISO IS 18183: "Public broadcast reception".
- [i.56] IEEE 1609.5: "Standard for Wireless Access in Vehicular Environments (WAVE) - Communication Manager".
- [i.57] IEEE 1609.1: "Standard for Dedicated Short Range Communications (DSRC) Resource Manager".
- [i.58] IEEE 1609.0: "Trial-Use Standard for Wireless Access in Vehicular Environments (WAVE) - Architecture".
- [i.59] IEEE 1609.3: "IEEE Draft Standard for Wireless Access in Vehicular Environments (WAVE) - Networking Services".
- [i.60] IEEE 1609.4: "IEEE Draft Standard for Wireless Access in Vehicular Environments (WAVE) - Multi-Channel Operation".
- [i.61] IEEE 1609.2: "Standard for Wireless Access in Vehicular Environments - Security Services for Applications and Management Messages".
- [i.62] ETSI TS 102 731: "Intelligent Transport Systems (ITS); Security; Security Services and Architecture".
- [i.63] ETSI TS 102 894: "Intelligent Transport System (ITS); Users & Applications requirements; Facility layer structure, functional requirements and specifications".
- [i.64] ETSI EN 302 895: "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Local Dynamic Map (LDM) Specification".
- [i.65] ETSI TS 102 723: "Intelligent Transport Systems; OSI cross-layer topics; Part 11: Interface between network and transport layers and facilities layer".
- [i.66] ETSI TR 102 893: "Intelligent Transport Systems (ITS); Security; Threat, Vulnerability and Risk Analysis (TVRA)".
- [i.67] ETSI ES 202 910: "Intelligent Transport Systems (ITS); Security; Identity Management and Identity Protection in ITS".
- [i.68] ETSI ES 202 663: "Intelligent Transport Systems (ITS); European profile standard for the physical and medium access control layer of Intelligent Transport Systems operating in the 5 GHz frequency band".
- [i.69] ISO IS 13181 (all parts): "CALM Security".

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## 3 Definitions and abbreviations

### 3.1 Definitions

For the purposes of the present document, the terms and definitions given in [i.7], [i.8], [i.13], [i.22] and the following apply:

**conformance testing:** process for testing that an implementation is compliant with a protocol standard, which is realized by test systems simulating the protocol with test scripts executed against the implementation under test

**Interoperability testing:** process for testing that devices can inter-operate, which is realized by connecting devices from different vendors and operating them, either manually or automatically, according to scenarios based on a protocol standard

**Testing framework:** document providing guidance and examples necessary for the development and implementation of a test specification

### 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in [i.7], [i.8], [i.13], [i.22] and the following apply:

|     |                                  |
|-----|----------------------------------|
| RP  | Reference Point                  |
| SDO | Standard Developing Organisation |

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## 4 ITS foundations

### 4.1 Motivation for and structure of the document

In order to carry out thorough protocol conformance and interoperability testing, complex test beds would be needed. In practice, it looks much more feasible to perform protocol conformance and interoperability tests in a simulated environment. A protocol conformance and interoperability testing framework for ITS thus is essential for a systematic and consistent approach towards testing of globally applicable ITS communications equipment.

The ITS testing framework presented in the present document is a set of guidelines for conformance testing and interoperability testing. It is based on the common architecture for communications in ITS from ETSI and ISO. Although it is referring explicitly to a consistent set of ITS base standards from ETSI and ISO, in no way it is restricted to this set of ITS base standards. Further on, it is enabling in a sense, that a manufacturer can implement and test those functionalities, considered to be important for market access.

The remaining part of clause 4 gives a short tutorial on communications in ITS. For more details existing base ITS standards from ETSI and ISO are listed.

Clause 5 provides an introduction to the ITS testing framework.

Clause 6 describes the approach for conformance testing.

Clause 7 describes the approach for interoperability testing.

Clause 8 provides more detailed guidance for the development of formal ITS test specifications and test suites.

Annex A provides information on the generic approach for interoperability testing.

## 4.2 ITS environment

The ITS architecture is presented in [i.13], [i.22] using different views. Main views presented are the top level networking view and the ITS station reference architecture view.

The top level networking view [i.13], [i.22] is presented in figure 1. A more implementation-oriented presentation is given in [i.17]. It is presumed that communication within a single network does not meet all the requirements of all ITS applications. Instead combinations of networks are envisioned, in which multiple ITS access and networking technologies are applied.

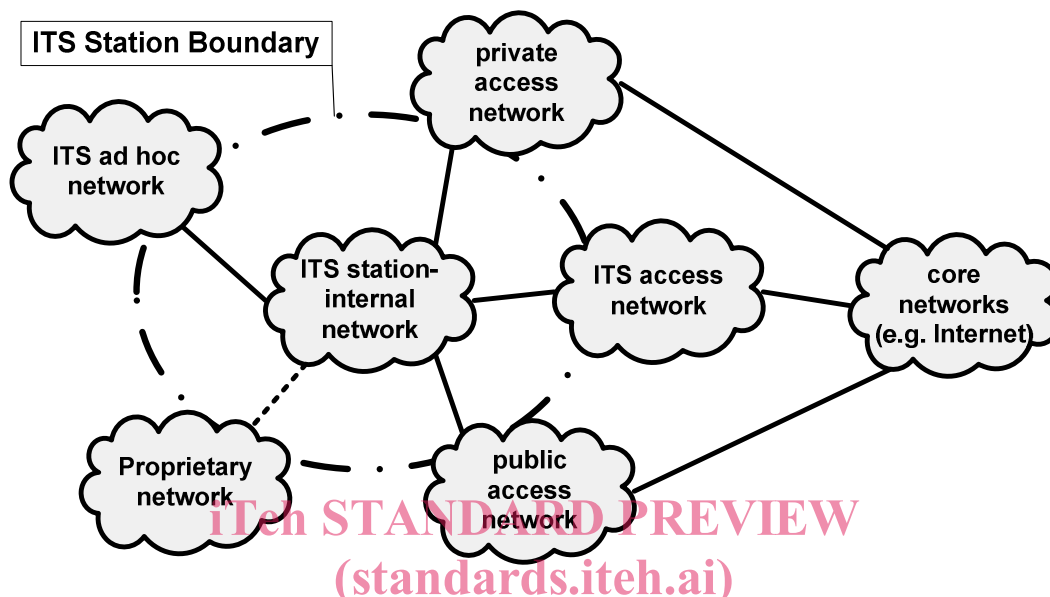


Figure 1: Top level networking view of ITS

The networks are grouped into [SIST-V ETSI/EG 202 798 V1.1.1:2011](https://standards.iteh.ai/catalog/standards/sist/a27fb85f-641b-43a6-b869-234096fda60f/sist-v-etsi-eg-202-798-v1-1-1-2011)

- ITS domain:
  - ITS station-internal network;
  - ITS station-external network:
    - ITS ad-hoc network;
    - ITS access network.
- Generic domain:
  - all other networks.

ITS are composed of four different ITS sub-systems, i.e. vehicular sub-system (cars, trucks, emergency vehicles, etc.), road-side sub-systems, central sub-systems and personal (portable) sub-systems as specified in [i.22], [i.13] presented in figure 2.

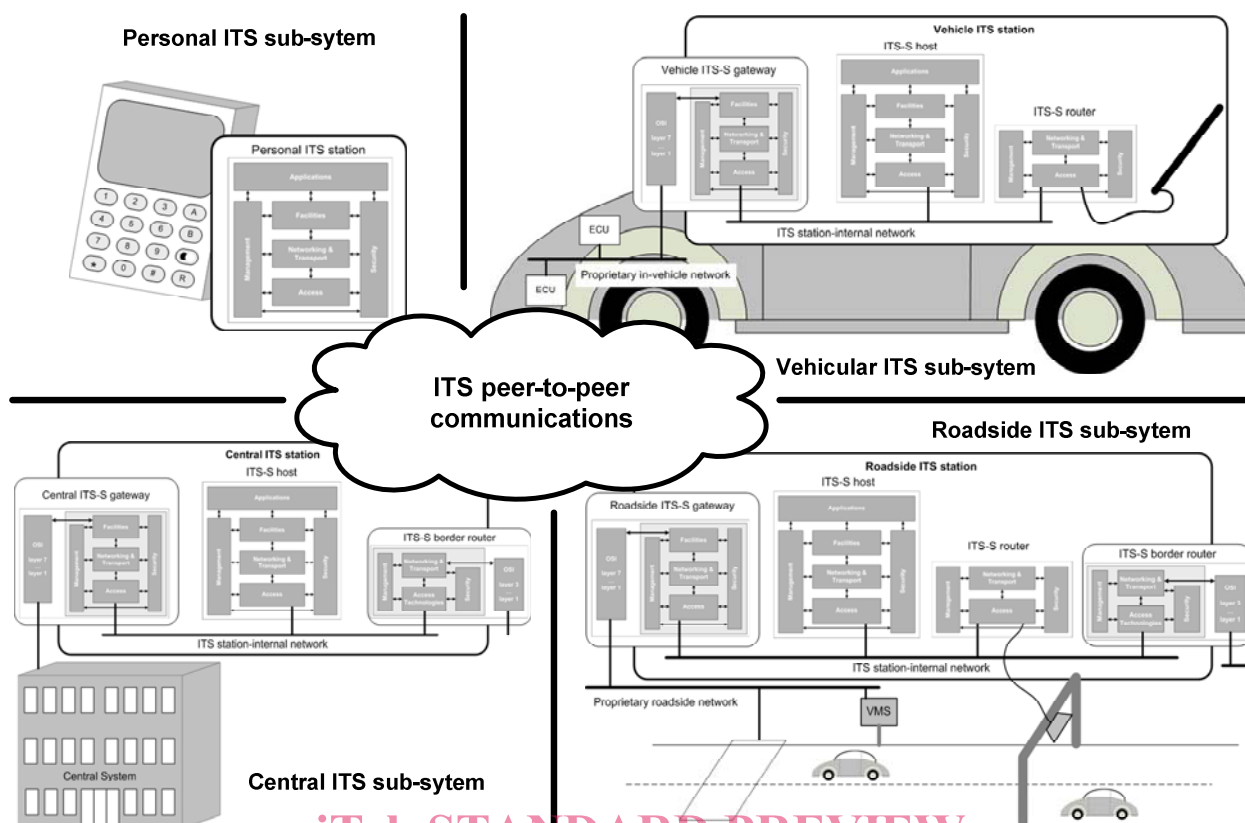


Figure 2: ITS sub-systems [i.13], [i.22]

Each ITS sub-system contains an ITS station with functionality as specified in the ITS station reference architecture presented in figure 3.

NOTE: The term "ITS station" (ITS-S) indicates a set of possible functionalities rather than a physical unit.

ITS stations act as peer stations in communication networks applying different access technologies, different networking & transport protocols, different facility protocols and the related security and management functionalities. The communication media usually are wireless. The various layers and entities in the ITS station reference architecture are interconnected via interfaces MI, MN, MF, MA, SI, SN, SF, SA, MS, IN, NF, FA [i.22], [i.13], see figure 3.

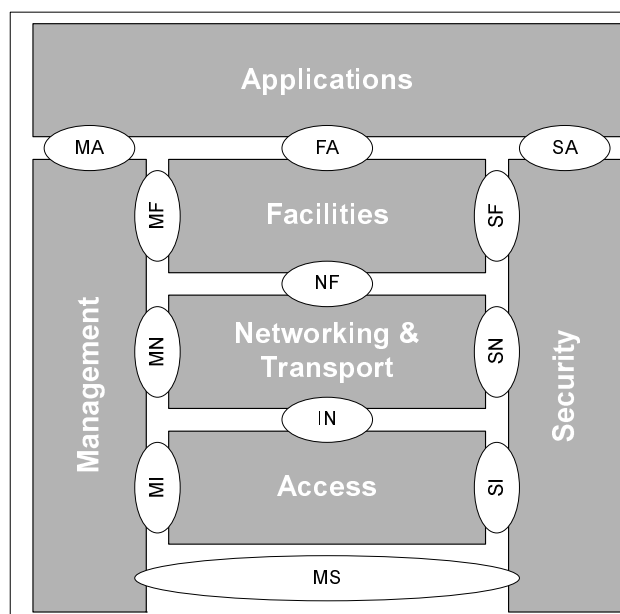


Figure 3: ITS station reference architecture [i.13], [i.22]

Accessibility of these interfaces may be dependent on the implementation.

Table 1 presents the layers and entities of the ITS station reference architecture being present in ITS-functional components.

**Table 1: Summary of ITS layers and entities in ITS-S functional components**

| Main objects<br>(ITS sub-systems)          | ITS-S<br>functional<br>components | Layers and entities |                    |                                |                |                    |                  |
|--|-----------------------------------|---------------------|--------------------|--------------------------------|----------------|--------------------|------------------|
|  |                                   | Applications        | Facilities<br>(FL) | Networking &<br>Transport (NL) | Access<br>(AL) | Management<br>(ME) | Security<br>(SE) |
| Vehicle<br>Roadside<br>Central<br>Personal | ITS-S host                        | X                   | X                  | X                              | X              | X                  | X                |
|  | ITS-S router                      |                     |                    | X                              | X              | X                  | X                |
|  | ITS-S gateway                     |                     | X                  | X                              | X              | X                  | X                |
|  | ITS-S border<br>router            |                     |                    | X                              | X              | X                  | X                |

## iTeh STANDARD PREVIEW (standards.iteh.ai)

[SIST-V ETSI/EG 202 798 V1.1.1:2011](https://standards.iteh.ai/catalog/standards/sist/a27fb85f-641b-43a6-b869-234096fda60f/sist-v-etsi-eg-202-798-v1-1-1-2011)

<https://standards.iteh.ai/catalog/standards/sist/a27fb85f-641b-43a6-b869-234096fda60f/sist-v-etsi-eg-202-798-v1-1-1-2011>