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Intelligent transport systems — Fast service announcement protocol (FSAP) for general purposes in ITS

Systèmes de transport intelligents — Protocole d'annonce de service rapide (FSAP)

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 278, *Intelligent transport systems*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 22418:2018), which has been technically revised. The main changes compared to the previous edition are as follows:

— this document has been editorially aligned with draft ETSI EN 302 890-1 in order to make these two standards complement each other such that both can be published as European standards;

— one minor technical detail of the ASN.1 code related to a specific extension element was harmonized with ETSI.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Provisioning of ITS services at specific locations on the road network requires awareness of the availability and the purpose of such services in order to allow a road network user to make decisions on the potential consumption of such a service. Awareness of services can be achieved by pull and push mechanisms. Whilst pull mechanisms are well understood and deployed for non-time-critical usage, several use cases depend on a push mechanism. Whilst pull mechanisms require a-priori knowledge of an intended service, push mechanisms support also "mandatory services" that may be locally and dynamically applicable and defined by local policies rather than global regulations.

This document illustrates and specifies the features of the cooperative push mechanism "service announcement" based on the internationally harmonized message formats specified in ISO/TS 16460, and builds on any localized ITS-S communications protocol stack (ITS-SCPS), one of which is FNTP, specified in ISO 29281-1, which builds on the ITS-M5 access technology specified in ISO 21215. It is to be noted that the terms "service announcement" and "service advertisement" are used synonymously.

This document complements service announcement specifications at IEEE ("WAVE Service Advertisement" [WSA] specified in IEEE 1609.3[TM]) and at ETSI ("Service Announcement Essential Message" [SAEM] specified in draft ETSI EN 302 890-1):

— The WSA requires normatively only a subset of the functionality specified in ISO/TS 16460. WAVE is designed for the IEEE 802.11(TM) OCB localized communications access technology operated in the 5,9 GHz frequency bands allocated in the United States of America, also referred to as "US-DSRC".

— The SAEM, also using the message formats specified in ISO/TS 16460, is tailored in support of a limited ITS service domain identified in ETSI as "Basic Set of Applications", using only a small subset of functionality specified in ISO/TS 16460 and in this document. So far, ETSI requires usage of the ITS-S communication protocol stack constituted by ITS-G5, GeoNetworking, the Basic Transport Protocol and the common ETSI message header.

Using the same ITS-SCPS for transmission of the service announcement message (SAM) and the same limited subset of service announcement functionality, FSAP, WSA, and SAEM are binary compatible with respect to the shared service announcement features.

Understanding service advertisement and the related protocol specified in this document requires understanding of ISO/TS 16460.

Requirements are specified in the following clauses of this document.

— Clause 5 specifies general requirements.

— Clause 6 presents a tutorial on architectural issues related to FSAP.

— Clause 7 specifies protocol elements of FSAP.

— Clause 8 specifies protocol procedures of FSAP.

— Clause 10 specifies conformance declaration.

— Clause 11 specifies test methods.

— Annex A specifies the ASN.1 module for FSAP.

— Annex B specifies details of the optional support of presenting communication requirements of FSAP to the ITS station management in conformance with ISO 17423.

— Annex C specifies details of the optional support of path and flow management for FSAP in conformance with ISO 24102-6.

— Annex D presents the implementation conformance statement proforma.

Intelligent transport systems — Fast service announcement protocol (FSAP) for general purposes in ITS

1 Scope

This document specifies the fast service announcement protocol (FSAP) for general purposes in ITS. It references and supports all features of ISO/TS 16460, especially supporting the service response message (SRM) and related features in addition to the service announcement message (SAM), which enables only very basic features.

FSAP supports locally advertised ITS services uniquely identified by an ITS application identifier (ITS-AID).

This document specifies message formats and related basic protocol procedures by reference to ISO/TS 16460, and further related protocol requirements for operation of FSAP in the context of an ITS station specified in ISO 21217.

This document illustrates its relations to service announcement protocols specified by ETSI TC ITS and IEEE.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 8825-2, *Information technology — ASN.1 encoding rules: Specification of Packed Encoding Rules (PER) — Part 2*

ISO/IEC 8825-7, *Information technology — ASN.1 encoding rules — Part 7: Specification of Octet Encoding Rules (OER)*

ISO/TS 16460, *Intelligent transport systems — Communications access for land mobiles (CALM) — Communication protocol messages for global usage*

ISO 17419, *Intelligent transport systems — Cooperative systems — Globally unique identification*

ISO 17423, *Intelligent transport systems — Cooperative systems — Application requirements and objectives*

ISO 21217, *Intelligent transport systems — Communications access for land mobiles (CALM) — Architecture*

ISO 29281-1, *Intelligent transport systems — Localized communications — Part 1: Fast networking & transport layer protocol (FNTP)*

ISO 24102-3, *Intelligent transport systems — ITS station management — Part 3: Service access points*

ISO 24102-4, *Intelligent transport systems — ITS station management — Part 4: Station-internal management communications*

ISO 24102-6, *Intelligent transport systems — Communications access for land mobiles (CALM) — ITS station management — Part 6: Path and flow management*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21217 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 Abbreviated terms

APDU	application protocol data unit
FSAM	fast service advertisement message
FSAP	fast service announcement protocol
FSRM	fast service response message
ITS-AID	ITS application identifier
ITS-SAPID	ITS-S application process identifier
ITS-SCPS	ITS station communication protocol stack
REQN	request message PDU, no response message PDU expected
REQW	request message PDU, response message PDU expected
RES	response message PDU, acknowledging a REQW
SAEM	service announcement essential message
SAM	service announcement message
SRM	service response message
S-FSAM	secured FSAM
S-FSRM	secured FSRM
SrvIniP	service initialization phase
SrvOpP	service operation phase

5 General requirements

The normative part of the specification of the service advertisement messages in ISO/TS 16460 is a normative part of this document.

The FSAP specified in this document shall be identified in FSAP APDUs by the version number three.

APDUs specified in this document are the FSAM and the FSRM.

The messages for FSAM and FSRM shall be encapsulated by a security frame, resulting in a S-FSAM and a S-FSRM.

Fragmented transmission of FSRMs and FSAMs is prohibited. Thus, the maximum size of S-FSAMs and S-FSRMs is limited by the capabilities of the protocol stack used for transmission.

FSAP is identified at the ITS-S networking and transport layer by:

— the well-known registered ITS port number (ITS-PN) PORT_SAM = 1 = 0x00.01, identifying the FSAP port that is receiving groupcasted S-FSAMs, and

— dynamically assigned ITS-PNs:

  — PORT_DYN_FSAM identifying the FSAP port that is receiving unicast S-FSAMs. The dynamic assignment is done in the ITS-SU that is transmitting S-FSRMs;

  — PORT_DYN_FSRM identifying the FSAP port that is receiving unicast S-FSRMs. The dynamic assignment is done in the ITS-SU that is transmitting S-FSAMs;

as illustrated in Table 1; see also 7.3 on ITS port numbers.

Table 1 — FSAP ITS port numbers

Direction	Source ITS-PN	Destination ITS-PN	MAC mode
From service advertiser to service user	PORT_DYN_FSRM	PORT_SAM	Groupcast (broadcast or multicast)
		PORT_DYN_FSAM	Unicast
From service user to service advertiser	PORT_SAM	PORT_DYN_FSRM	
	PORT_DYN_FSAM		

NOTE Procedures on how to perform multicast transmission of S-FSAMs are not specified in this document.

Unicast transmissions of S-FSRMs and S-FSAMs may be repeated, e.g. after timeout for a respective acknowledgement, as defined by implementation.

Further on the FSAP is identified by:

— the ITS-AID 2.113.664; see also 7.4. The pencoded (ASN.1 unaligned packed encoding rules) presentation of this number of ASN.1 type `ITSaid` specified in ISO 17419 is 0pE0.00.00.00, i.e. fits into a four octet field.

An implementation supporting path and flow management shall conform to ISO 24102-6.

An implementation for a distributed ITS-SU, i.e. an ITS-SU consisting of several ITS-SCUs interconnected with an ITS station-internal network, shall conform to ISO 24102-4.

As

— identical message formats for service advertisement are used in IEEE 1609.3(TM) (WAVE SAM) and ETSI TS 102 890 (SAEM), and

— the features specifications in IEEE 1609.3(TM) and ETSI TS 102 890 are sub-sets of the specification in this document,

an implementation of FSAP optionally may support the service advertisement from IEEE WAVE devices and the service announcement from ETSI ITS stations by considering the following:

— WSM support

  1) The only supported access technology is IEEE 802.11(TM) OCB mode specified in IEEE 802.11(TM) (ISO 21215 with US frequency allocation and WAVE-specific details).

  2) The only networking & transport layer protocol supported is the WAVE Short Message protocol (WSMP) specified in IEEE 1609.3(TM), which uses the same message format as FNTP with TPID-FS zero (ISO 29281-1).

  3) Port numbers are not used. Instead, the service advertisement message SAM is identified by the value 135 of ITS-AID, used as a transport layer destination address in WSMP (i.e. in FNTP with TPID-FS zero [ISO 29281-1]).

  4) The WAVE SAM is identical to FSAM.

5) S-FSAM (Security encapsulated FSAM) uses the same format and encoding as WAVE does. WAVE security is specified in IEEE 1609.2(TM).

6) FSRM and other features, e.g. mandatory applications and private service channels, are not supported.

— SAEM support

1) The only supported access technology is IEEE 802.11(TM) OCB mode (ISO 21215 with EU frequency allocation and ETSI-specific details), referred to as ITS-G5.

2) The only networking & transport layer protocol currently supported is ETSI GeoNetworking/ ETSI Basic Transport Protocol.

3) The SAEM is identified by the BTP port number for SAM specified in ETSI TS 103 248.

4) The SAEM is SAEM preceded by the ETSI common message header.

5) Security encapsulation is not specified.

6) FSRM and other features, e.g. mandatory applications and private service channels, are not supported.

Details of support of application requirements for communications, if supported in an implementation, shall be as specified in Annex B. Details of path and flow management, if supported in an implementation, shall be as specified in Annex C.

6 Architecture

6.1 ITS communications architecture

The FSAP is designed as a functionality of the ITS station and communication architecture specified in ISO 21217.

6.2 Implementation architecture

The FSAP specified in this document supports the implementation architectures introduced in ISO 21217.

6.3 Communication roles and entities

The FSAP distinguishes the following roles identified in ISO/TS 16460:

a) Service advertiser:

— management of advertisement requests from service providers;

— transmission of FSAMs and reception of FSRMs.

b) Service provider:

— provision of ITS services.

c) Service user:

— reception of FSAMs and transmission of FSRMs;

— consumption of ITS services.

An ITS-SU may simultaneously or sequentially act as a service advertiser, service provider, and service user.

This document does not explicitly consider the distinction of service advertiser ITS-SUs and service provider ITS-SUs; for the purpose here, the two roles are assumed to be located in the same ITS-SU.

An instance of any kind of ITS station identified in ISO 21217 (roadside, vehicle, portable, centre) may implement the FSAP.

6.4 Communication phases

6.4.1 Overview

In order to allow an ITS-SU to offer an ITS service to another ITS-SU by means of an application session, a service initialization phase (SrvIniP) is performed by the FSAP, where the SrvIniP is based on localized communication, e.g. applying the FNTP networking & transport layer protocol specified in ISO 29281-1.

After initialization, the application session is performed during the service operation phase (SrvOpP), where the SrvOpP may be based on either localized communication or networking, e.g. IPv6 communication, over any kind of access technology.

During SrvIniP, handover to another protocol stack, e.g. another access technology and IPv6, may be demanded.

The real-time SrvIniP procedures are preferably implemented in an ITS-S router.

NOTE The specification of SrvOpP is outside the scope of this document.

6.4.2 Service initialization phase

The purpose of SrvIniP is to invite a peer ITS-SU by means of a fast service announcement message (FSAM) to use an ITS service which is uniquely identified by an ITS-AID specified in ISO 17419; ITS-AID points to an ITS application object.

NOTE 1 Usage of some allocated ITS-AID values are not always meaningful in FSAM.

Acceptance of such an invitation typically results in a session where the two peer ITS-S applications exchange data. However, a session is not necessarily needed, i.e. the service may be provided completely by the FSAM. Thus, FSAM provides also the means to periodically broadcast information from ITS broadcast services.

Three operational options of SrvIniP are specified. The distinction was originally motivated by the two ITS application objects:

a) ITS application class (ISO 15628), and

b) ITS application,

and was extended to allocate private communication channels to individual ITS station units (ITS-SUs).

Option a), originally designed for ITS application classes (DSRC-like SrvIniP, see ISO 15628), is illustrated in Figure 1. FSAM is sent by a service advertiser ITS station to invite for a service initialization phase. FSRM is sent by a service user ITS station to acknowledge FSAM. Successful SrvIniP is given by the first successful REQW or REQN of the service provider.

NOTE 2 In ISO 15628, BST corresponds functionally to FSAM, and VST corresponds functionally to FSRM.

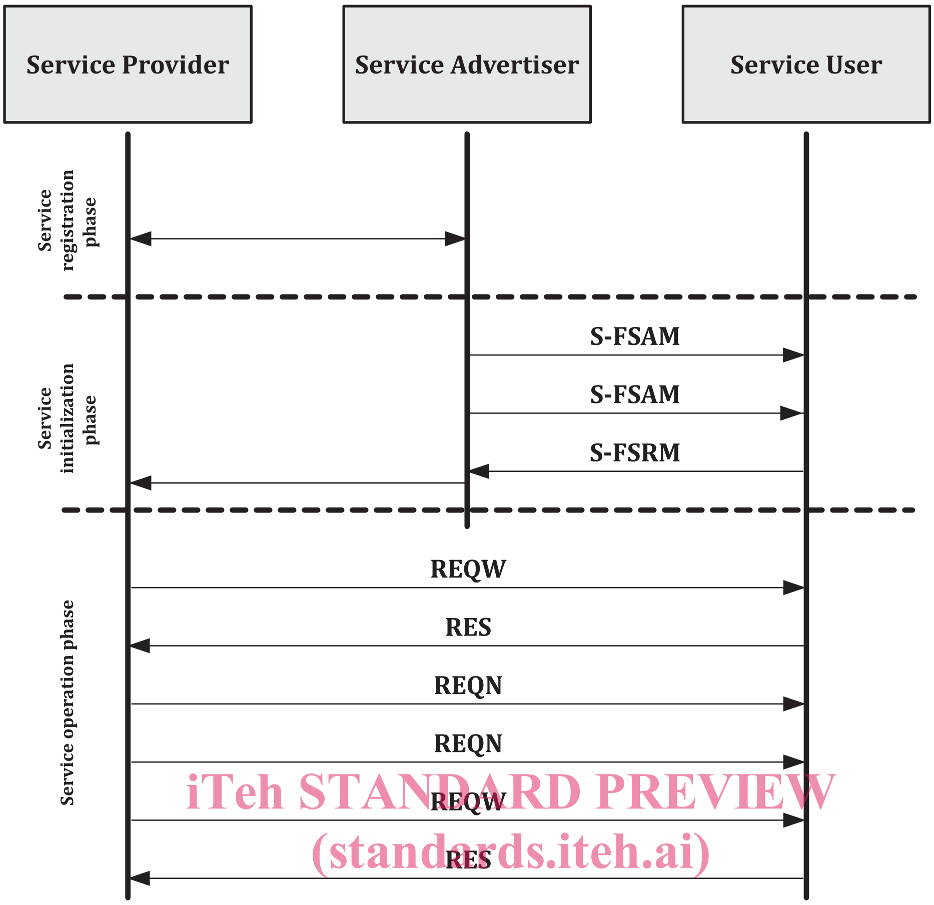

Figure 1 — ITS application session with FSRM

NOTE 3 The concept of application classes was introduced in ISO 15628. Distinction of classes was performed with an identifier of ASN.1 type `DSRCapplicationEntityID`. The difference between an ITS application class and an ITS application is that for an ITS application class several contexts exist. Each context itself can be referred to as an ITS application.

During a SrvOpP:

— requests, either with or without an expected response, are typically sent by the service provider, but may also be sent by the service user, and

— responses are typically sent by the service user, but may also be sent by the service provider,

dependent on the specification of the ITS application.

NOTE 4 Rules on which data are sent by a service provider or by a service user apply strictly for ISO 15628. In general, for ITS there are no such rules.

NOTE 5 As specified in ISO 21217, the service user and service client instances of an ITS application are referred to as ITS-S application processes; ITS-S application processes residing in the "Applications" entity are referred to as ITS-S applications.

Option b), originally designed for ITS applications (WAVE-like SrvIniP)[3], is illustrated in Figure 2. FSAM is sent by a service advertiser to perform service initialization. Successful SrvIniP is given by the first successful REQW or REQN of the service user.

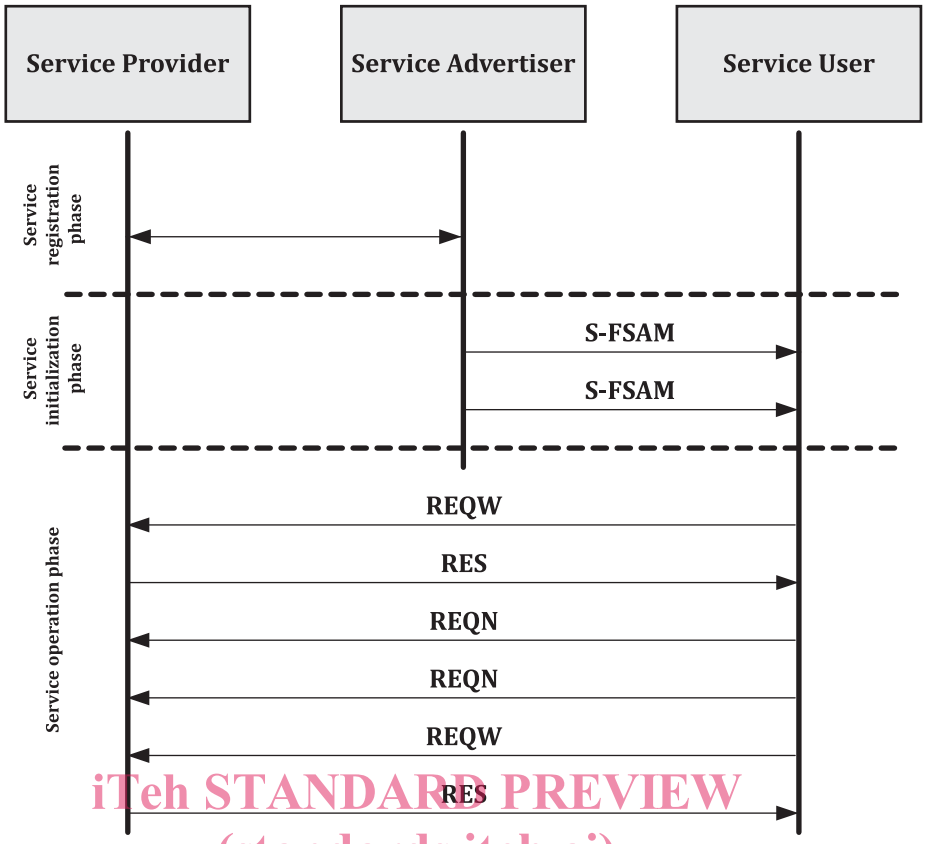

Figure 2 — ITS application session without FSRM

During a SrvOpP:

— requests, either with or without an expected response, are typically sent by the service user, but may also be sent by the service provider, and

— responses are typically sent by the service provider, but may also be sent by the service user,

dependent on the specification of the ITS application.

NOTE 6 In general for ITS there is no such strict rule regarding which station type is sending which type of message.

Option c) presents the situation when a service advertiser wants to allocate private communication channels to service users. In this option, an additional handshake between the service advertiser and the service user is needed prior to start of the SrvOpP. Option c) is applicable for ITS applications and ITS application classes.

NOTE 7 "Private communication channel" does not necessarily mean that only a single service user station operates on it. It is up to the service advertiser station to allocate a private communication channel to one or several service user stations.

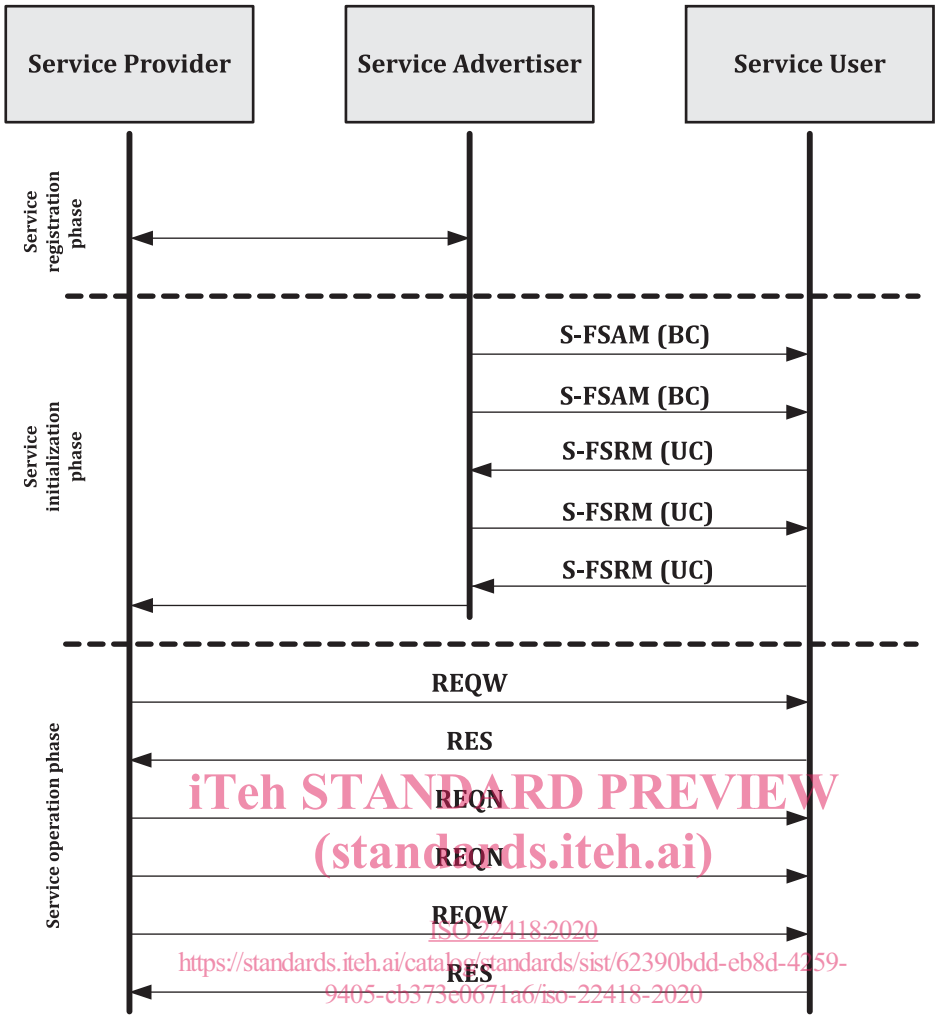

Figure 3 — ITS application session with privately allocated communication channel

6.4.3 Service operation phase

Management of reception and transmission of session messages, e.g.

— "Request with No response expected" (REQN),

— "Request With response expected" (REQW), and

— "Response to a request" (RES),

as illustrated in Figures 1, 2, and 3, is outside the scope of this document.

6.5 Advertised services

ITS services being advertised with FSAP are provided by ITS applications which are typically specified with two complementary ITS-S application processes, e.g. one implementing the provider part, the other implementing the user part; see ISO 21217.

An ITS application is uniquely identified by an ITS-AID specified in ISO 17419. The one or several ITS-S application processes of such a single ITS application are distinguished by means of the ITS-S application process identifier (ITS-SAPID) specified in ISO 17419. Thus, a specific ITS-S application process is uniquely identified by the tuple {ITS-AID, ITS-SAPID}.

ITS-SAPIDs can also be used to distinguish different versions of the ITS-S application process.

In order to identify and execute the proper ITS-S application processes during the SrvOpP, two approaches are identified:

a) management by FSAP;

b) management by the ITS application not using specific features of FSAP.

Approach a) defines an ITS application in general as an ITS application class, i.e. an ITS application with different contexts (see ISO 17419). Thus, upon reception of an FSAM advertizing such an ITS application class, the service user station first will reply with an FSRM presenting the supported ITS-SAPID values. Based on this information, the service provider will select a suited ITS-S application process identified by the ITS-SAPID, if possible, or will not be able to provide the service.

A possible procedure b) would be to use version numbers in the APDUs of the ITS-S application processes, allowing a receiving entity to select the appropriate protocol.

6.6 FSAP reference architecture

The FSAP reference architecture is illustrated in Figure 4.

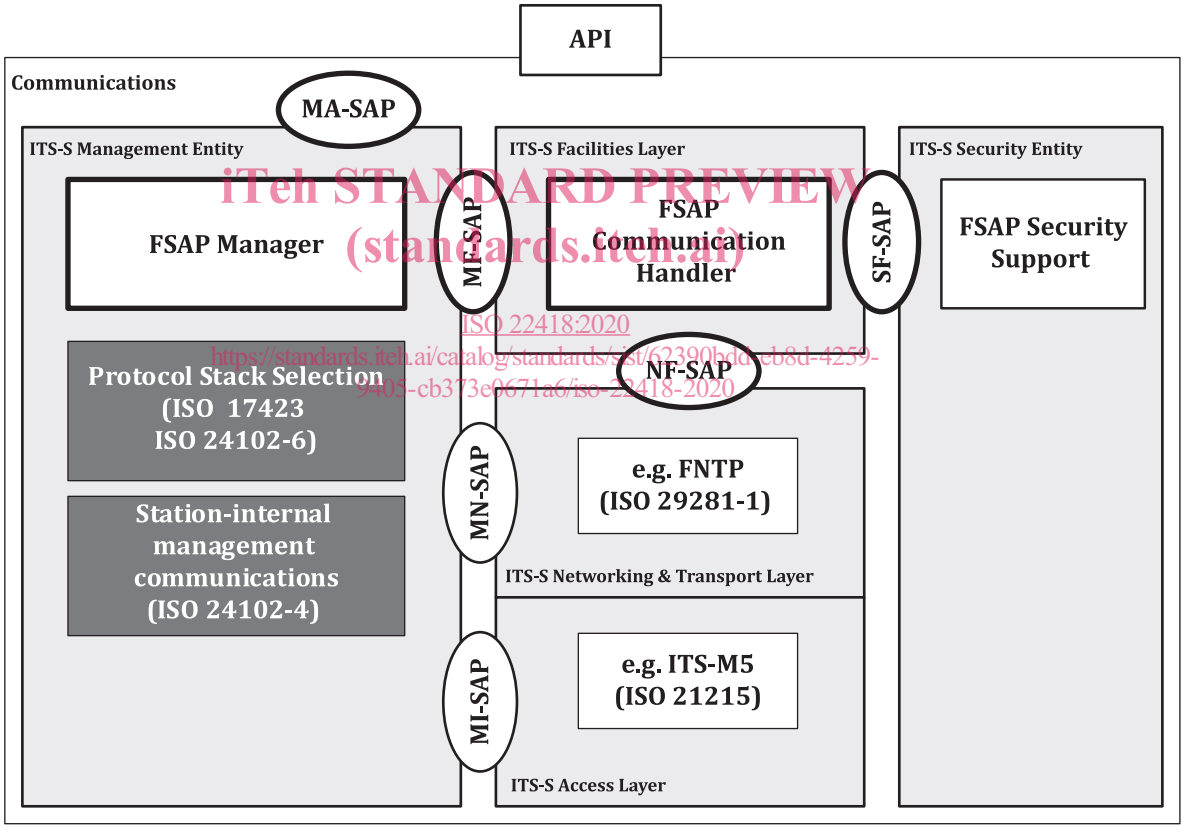

Figure 4 — FSAP reference architecture

The FSAP is specified by means of two functional entities located in the ITS station, see ISO 21217, i.e.

— "FSAP communication handler" located in the ITS-S facilities layer;

— "FSAP manager" located in the ITS-S management entity.

Security services in support of FSAP are located in the ITS-S security entity shown in Figure 4. Related specifications, except very general ones in 7.2.4, are out of scope of this document.