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Intelligent transport systems — Localized communications —

Part 1: Fast networking & transport layer protocol (FNTP)

Systèmes intelligents de transport — Communications localisées —
Partie 1: Réseautique rapide et protocole de la couche transport

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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 on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

This second edition cancels and replaces the first edition (ISO 29281-1:2013), which has been technically revised. It also incorporates the Amendment ISO 29281-1:2013/Amd1:2017.

The main changes compared to the previous edition are as follows:

— a complete technical revision in support of the common message format specified in ISO TS 16460 that is harmonized with IEEE WAVE;

— ASN.1 has been aligned with latest developments in ISO TC 204;

— provisioning for path and flow management has been added;

— normative annex related to conformance testing, that contains the PICS proforma, has been added.

A list of all parts in the ISO 29281 series can be found on the ISO website.

Introduction

This document is part of a family of International Standards for communications in Intelligent Transport Systems (ITS) based on the ITS station and communication architecture specified in ISO 21217.

This document is Part 1 of a multipart standard which determines the "Intelligent Transport Systems" (ITS) localized communications.

The FAST Networking & Transport layer Protocol (FNTP) is a protocol for localized communications. FNTP comprises

— a basic port mapper protocol, used for localized communications between ITS station units (ITS-SUs),

— networking related protocol features for

  — null-networking (single-hop communications),

  — N-hop forwarding,

  — ITS station-internal forwarding of packets between ITS station communication units (ITS-SCUs) with ITS-S host role and ITS-S router role,

  extendible with further features;

— transport related protocol features for

  — information dissemination with ITS-AID as destination address,

  — session support with ITS port numbers (ITS-PN) as source address and destination address,

  — LPP,

  extendible with further features.

The first version (2010) of FNTP was validated in the CVIS project of the European Commission. Feedback from CVIS and other activities resulted in the second version (2013). This third version of FNTP is the result of harmonization with the IEEE WAVE Short Message Protocol (WSMP); it is based on the common message format specified in ISO TS 16460.

Intelligent transport systems — Localized communications —

Part 1:
Fast networking & transport layer protocol (FNTP)

1 Scope

This document specifies the "Fast Networking & Transport Protocol" (FNTP) of the ITS-S networking & transport layer.

FNTP is in support of efficient localized communications distinguishing networking related features and transport related features. FNTP is extendible in the future without breaking binary backward compatibility.

This document specifies

— message formats and related basic protocol procedures by reference to ISO TS 16460, and

— further requirements for operation of FNTP in the context of an ITS station specified in ISO 21217.

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

ISO 17419, *Intelligent Transport Systems — Cooperative systems — Classification and management of ITS applications in a global context*

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

ISO 21218, *Intelligent transport systems — Hybrid communications — Access technology support*

ISO 24102-3[1)], *Intelligent transport systems — ITS station management — Part 3: Service access points*

ISO 24102-4[2)], *Intelligent transport systems — ITS station management — Part 4: Station-internal management communications*

ISO 24102-6, *Intelligent transport systems — 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 and the following apply.

1) 2nd edition to be published. Stage at time of publication: ISO/DIS 24102-3.

2) 2nd edition to be published. Stage at time of publication: ISO/DIS 24102-4.

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

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

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

3.1
ITS-S facility layer service
process residing in the ITS-S facilities layer acting as source or destination of FNTP NPDUs

4 Abbreviated terms

FNTP	Fast networking & transport protocol
ITS-PN	ITS port number
ITS-S	ITS station
ITS-SCU	ITS station communication unit
ITS-SFS	ITS-S facility layer services
ITS-SU	ITS station unit
LM	Localized message
TPID-FS	Transport Protocol Identifier - Feature Selector
TPID	Transport Protocol Identifier
NPDU	Network Protocol Data Unit
UPER	Unaligned Packed Encoding Rules

5 General requirements

All normative requirements related to the specification of the "Localized Message" (LM) in ISO TS 16460 shall be normative requirements in this document.

The Fast Networking & Transport layer Protocol (FNTP) specified in this document is a communications protocol for the LM specified in ISO TS 16460. FNTP and the related LM format shall be identified in FNTP network protocol data units (NPDUs) by the version number three.

The term LM NPDU in ISO TS 16460 is synonym with the term FNTP NPDU specified in this document.

The FNTP is identified at the ITS-S access layer by the Ethertype value 35,152 = 0x8950 published on [9].

An implementation supporting path and flow management shall be in accordance with 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 be in accordance with ISO 24102-4.

The operational mode of subtype zero combined with TPID-FS zero, see 6.1, constitutes the interoperability mode of an ITS station unit (ITS-SU) with an IEEE WAVE device compliant with IEEE 1609.3[17]. In case of ITS-SUs that are declared to be interoperable with IEEE WAVE devices, this mode shall be used for single-hop broadcast communications with no expected reply if the respective value of ITS-AID as a destination address is registered at [11]. ITS-SUs that are not declared to be interoperable with IEEE WAVE devices may also use TPID-FS one for such broadcast communication.

The binary presentation of the LM is given by the ASN.1 specification presented in A.2 applying unaligned packet encoding rules (UPER).

As

— identical LM formats are used in FNTP and in WSMP specified in IEEE 1609.3[17], and

— the features specifications in IEEE 1609.3[17] is a sub-set of the specification of FNTP,

an implementation of FNTP optionally may support the WAVE short messages from IEEE WAVE devices by considering the following requirements for the interoperability mode:

1) The only supported access technology is IEEE 802.11 OCB mode specified in [18], which is given by ISO 21215[3] with US frequency allocation and WAVE-specific details.

2) The applicable EtherType value of the WSMP is 35,036 = 0x88DC of WSMP published on [9].

3) The only mandatory operational mode in WAVE-conformant devices is WSMP with subtype zero combined with TPID-FS zero.

NOTE Conformance tests for WSMP support are out of scope of this document.

6 Architectures

6.1 General context and purpose of FNTP

The FNTP specified in this document is designed as a protocol of the ITS-S networking & transport layer of the ITS station (ITS-S) architecture recognizing the concept of the bounded, secured and managed ITS-S specified in ISO 21217, and supporting the concept of ITS station communication units (ITS-SCU) and various implementation features; see ISO 24102-1[5] (local station management), ISO 24102-2[6] (remote station management), ISO 24102-3 (management and security service access points), ISO 24102-4 (station-internal management communications), and ISO 24102-6 (path and flow management).

FNTP is designed to enable localized communication between peer "ITS-S facility layer services" (ITS-SFSs) in ITS station units (ITS-SUs) with minimum protocol overhead. ITS-SFS are sources and destinations of FNTP NPDUs.

FNTP uses the LM format specified in ISO TS 16460, ISO TS 16460 specifies networking-related protocol features and transport-related protocol features. Networking-related protocol features are identified by means of a "Subtype" value. Transport-related protocol features are identified by means of a "Transport Protocol Identifier - Feature Selector" (TPID-FS).

Networking-related features supported by FNTP are:

— Subtype 0: Null-networking;

— Subtype 1: ITS station-internal forwarding;

— Subtype 2: N-hop forwarding.

Optional functionality is supported by means of N-Extensions. N-Extensions are type-length-value encoded data elements that contain networking-related information.

Transport-related features supported by FNTP are:

— TPID-FS 0: Information dissemination mode using ITS-AID as a destination port number;

— TPID-FS 1: General session mode using a destination ITS-PN and a source ITS-PN;

— TPID-FS 2: LPP mode.

Optional functionality is supported by means of T-Extensions. T-Extensions are type-length-value encoded data elements that contain transport-related information.

For a given transmission to a peer ITS-SU exactly one networking-related feature (Subtype zero or two) and one transport-related feature (TPID-FS zero, one, or two) is selected. For ITS station-internal forwarding the Subtype one FNTP N-Header precedes a complete FNTP-NPDU.

NOTE DSRC application layer legacy systems support specified in [8] makes use of FNTP.

FNTP supports hybrid communications by supporting any kind of ad-hoc access technology, e.g. ITS-M5[3], IR[2], 60GHz[4]. FNTP connects source and destination "endpoints" at the ITS-S facilities layers in peer ITS stations, where these endpoints are identified by "ITS-Port Numbers" (ITS-PNs), and where peer ITS station units are uniquely identified by a Link-ID of the access layer specified in ISO 21218. Consequently, FNTP basically is a port mapper protocol. FNTP may also be used for information dissemination, where an "ITS Application Identifier" (ITS-AID) takes the role of a destination port number.

6.2 FNTP reference architecture

Figure 1 illustrates the location of FNTP in the ITS station (ITS-S) specified in ISO 21217, and the station-internal relations with other protocol entities.

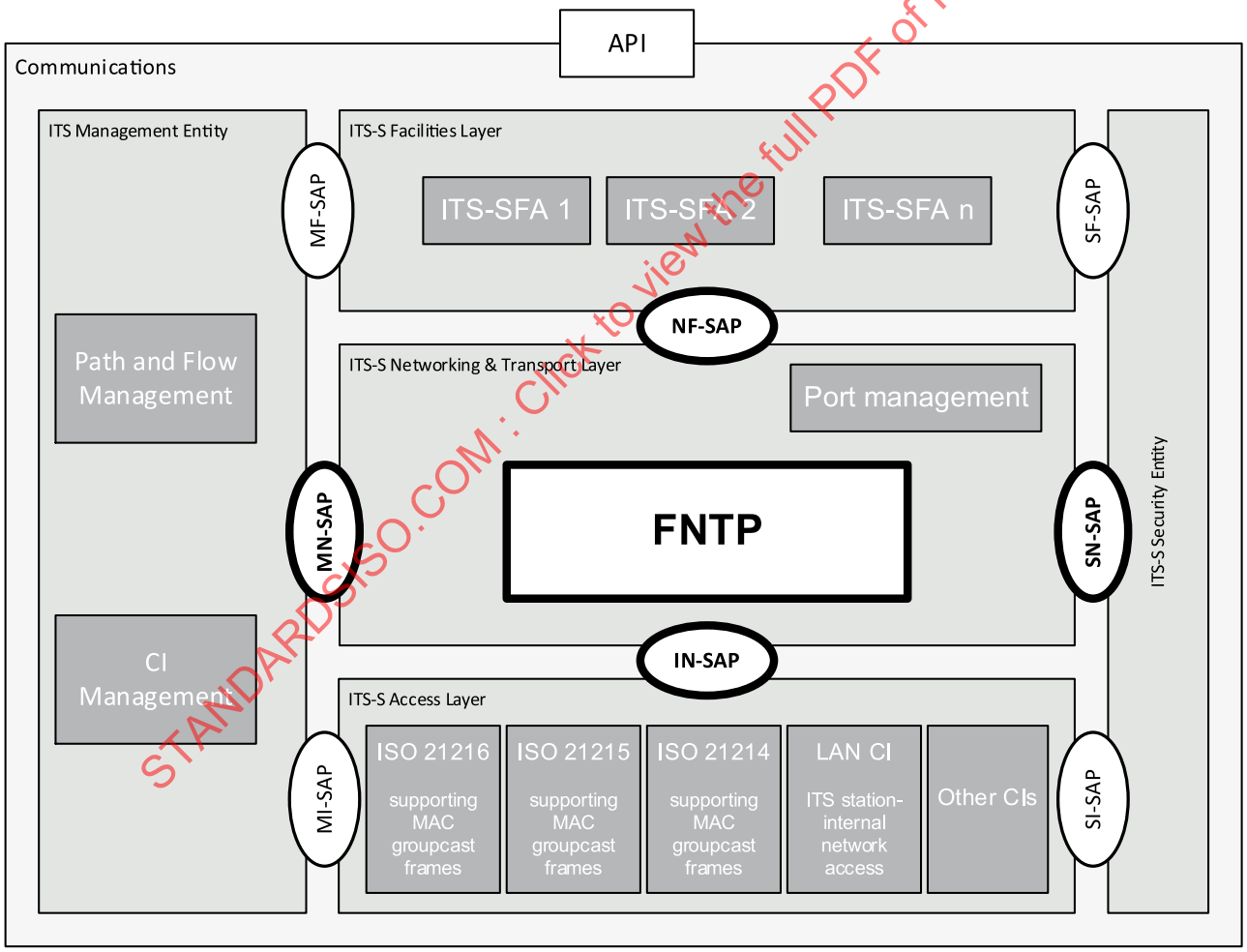

Figure 1 — FNTP reference architecture

"Port management" of FNTP is specified in 8.1.

Management of FNTP is supported in general with a "CI Selection Management" initially introduced in ISO 24102-1[5], with technical details of "Path and Flow Management" specified in ISO 24102-6[8].

Other management approaches are also possible, e.g. within a different station architecture, as long as interoperability based on the LM and on the functional protocol behaviour specified in this document is ensured.

6.3 Communication principles

6.3.1 Transmission

Transmission requests may be presented by the ITS-S facilities layer via the NF-SAP. Sources of messages in the ITS-S facilities layer are identified by ITS-PNs. Destinations of messages in the ITS-S facilities layer are identified by ITS-PNs or by well-known registered ITS-AIDs, dependent on TPID-FS. ITS-PNs may either be well-known registered numbers or dynamically assigned numbers. The registry of ITS-PNs is at [11].

Well-known registered ITS-AIDs are mapped to locally assigned ITS-PNs (i.e. dynamically assigned ITS-PNs - PORT_DYN, specified in ISO 17419) enabling a harmonized service access point towards the ITS-S facilities layer that uses only ITS-PNs but no ITS-AIDs.

Valid transmission requests to a groupcast MAC address are given by a "well-known" destination address (ITS-PN or ITS-AID) in combination with an existing groupcast VCI. The value of the source address (ITS-PN), if used, is irrelevant with respect of validity of a transmission request in case no reply is expected. Replies to groupcast messages are expected e.g. in case of the service advertisement message specified in ISO 24102-5[7].

Valid transmission requests to a unicast MAC address are given by any valid destination address in combination with an existing unicast VCI. The value of the source address, if present, is irrelevant with respect of validity of a transmission request in case no reply is expected.

Transmission requests are presented by the FNTP to the ITS-S access layer using services of the IN-SAP.

In implementations in accordance with ISO 24102-6, validity of a transmission request is given by a valid ITS-S-FlowID.

6.3.2 Reception

Reception notifications are presented by the ITS-S access layer to the FNTP using services of the IN-SAP.

Sources and destinations of messages are identified by ITS-PNs contained in the FNTP NPDU. ITS-AIDs used as destination address in FNTP NPDUs (TPID-FS = 0) are mapped to dynamically assigned ITS-PNs enabling a harmonized service access point NF-SAP towards the ITS-S facilities layer.

Valid notified packets addressed to an ITS-PN are given by a known destination port address (ITS-PN). Valid notified packets addressed to an ITS-AID are given by a known ITS-AID that is mapped to an ITS-PN. Which CI was used for reception of the packet, and which is the source port address of the packet, are not relevant for the validity of the packet, but are relevant for a potential reply.

Received packets indicating an FNTP version number that is not supported generally are invalid.

Notifications of received packets are presented by the FNTP to the ITS-S facilities layer using services of the NF-SAP.

6.3.3 FNTP ITS-PNs

ITS port numbers (ITS PNs) are two octet unsigned Integer numbers of ASN.1 type `PortNumber` specified in ISO 17419. ISO 17419 distinguishes well-known registered ITS-PNs (PORT_REG) and dynamically assigned ITS-PNs (PORT_DYN), and presents initial number allocations for PORT_REGs.

NOTE Static well-known ITS-PN numbers and ITS-AIDs are assigned to ITS applications by a registration authority; see ISO 17419. There are no dynamically assigned ITS-AIDs.

Dynamically assigned ITS-PNs (PORT_DYN) are unique only in the ITS-SCU that performed the assignment. In distributed implementations specified in ISO 21217, i.e. ITS-SUs consisting of several ITS-SCUs interconnected via an ITS station-internal network, always a pair of ITS-PNs are to be allocated, i.e. one value assigned in an ITS-SCU with host role, and a corresponding value assigned in an ITS-SCU with router role. This leads to the service look-up table specified in 7.4.2.

Allocation and deletion of dynamic and static well-known "ITS Port Numbers" (ITS-PNs) and ITS-AIDs in an ITS station is specified 8.1.

6.4 Implementation architectures

FNTP supports the implementation architectures introduced in ISO 21217.

7 Protocol elements

7.1 Service access points

NOTE SAPs are functional descriptions which in many cases are not implemented as observable interfaces. Thus in general SAPs are not testable. The requirements set up in this document with respect of SAPs thus just mean the functional behaviour rather than a specific implementation. As far as related ASN.1 definitions are given, these become mandatory as soon as the defined elements become observable, e.g. within a PDU for ITS station-internal management communications specified in ISO 24102-4[Z].

7.1.1 IN-SAP

The FNTP interacts with the ITS-S access layer specified in ISO 21217 using service functionality of the IN-SAP specified in ISO 21218.

The FNTP supports the IN-UNITDATA service functionality of the IN-SAP specified in ISO 21218.

The FNTP may support the IN-UNITDATA-STATUS and IN-UNITDATAACK service functionality of the IN-SAP specified in ISO 21218.

NOTE Usage of the information given by the IN-UNITDATA-STATUS service is not specified in this document.

7.1.2 NF-SAP

The FNTP interacts with the ITS-S facilities layer specified in ISO 21217 offering service functionality of the NF-SAP specified in Clause 11 and in A.2.

The FNTP provides the NF-FNTP-PORT service functionality and the NF-FNTP-COMM service functionality of the NF-SAP specified in this document.

7.1.3 MN-SAP

The FNTP interacts with the ITS-S management entity specified in ISO 21217 using service functionality of the MN-SAP specified in ISO 24102-3. This functionality is specified in A.3 by means of appropriate ASN.1 type definitions.

7.1.4 SN-SAP

The FNTP may interact with the ITS-S management entity specified in ISO 21217 using service functionality of the SN-SAP specified in ISO 24102-3. This functionality is specified in A.3 by means of appropriate ASN.1 type definitions.

7.2 FNTP NPDU

7.2.1 General

The format of FNTP NPDUs is identical to the format of LM NPDUs specified in ISO TS 16460:2016, 5.3.

7.2.2 Subtype zero

Support of subtype zero specified in ISO TS 16460 (Null-Networking) is mandatory. This is the default networking mode.

7.2.3 Subtype one

Support of subtype one specified in ISO TS 16460 is mandatory only in case an implementation supports an ITS station-internal network interconnecting several ITS-SCUs. Subtype one is only used for ITS station-internal forwarding of FNTP NPDUs. Usage of this subtype in links between peer ITS-SUs is prohibited.

The field "ITS-SCU-ID ITS-S host" contains the ITS-SCU-ID of the ITS-S host. ITS-SCU-ID is specified in ISO 24102-4, with its ASN.1 type `ITS-scuId` specified in ISO 17419.

The field "Link-ID VCI in ITS-S router" contains the Link-ID of the VCI in these ITS-S router. The format of Link-ID is specified in ISO 21218.

Usage of subtype one in the "Original N-Header" field is prohibited.

7.2.4 Subtype two

Support of subtype two specified in ISO TS 16460 is optional. Subtype two may be used to achieve resilience or minimum communication distance specified in ISO 17423[1]. Subtype two is restricted to broadcast or multicast dissemination of information disregard whether a reply is expected or not. Subtype two may be requested either in the NF-FNTP-COMM.request service primitive by indicating a Hop Count larger than zero, or by the ITS station management. The ITS station management may require an upper limit of Hop Count smaller than or equal to the possible maximum value of three.

7.2.5 N-Extensions

Table 1 presents currently identified N-Extensions.

Table 1 — N-Extensions

Name	Element ID	Comment
Transmit Power Used	4	Applicable for the access technology specified in ISO 21215[3]. Details specified in IEEE 1609.3[17].
802.11 Channel Number used	15	Applicable for the access technology specified in ISO 21215[3]. Details specified in IEEE 1609.3[17].
802.11 Data Rate used	16	Applicable for the access technology specified in ISO 21215[3]. Details specified in IEEE 1609.3[17].
a CIPs are constructed from I-Parameters specified in ISO 21218 and may depend on the ITS-S access technology selected for communications. Further details of CIPs are outside the scope of this document.		

Table 1 *(continued)*

Name	Element ID	Comment
Communication Interface receive parameters (RX-CIP)	80	Generally applicable. Specified in ISO 21218 and in this document.[a] Used for Subtype one to notify communication interface parameters in the ITS-SCU with router role related to the received FNTP NPDU.
Communication Interface transmit parameters (TX-CIP)	81	Generally applicable. Specified in ISO 21218 and in this document.[a] Used for Subtype one to request settings of communication interface parameters in the ITS-SCU with router role.
Channel Busy Ratio	82	Generally applicable, e.g. for channel congestion algorithms. Usage is not specified in this document.

[a] CIPs are constructed from I-Parameters specified in ISO 21218 and may depend on the ITS-S access technology selected for communications. Further details of CIPs are outside the scope of this document.

7.2.6 TPID-FS field

Details of the FNTP T-Header are selected by the value contained in the TPID-FS field of the FNTP N-Header.

7.2.7 TPID-FS zero - information dissemination mode

Support of TPID-FS zero is mandatory for ITS-SUs that are declared to be interoperable with IEEE WAVE devices. This "Information Dissemination Mode" is a transport mode of operation for transmission of FNTP NPDUs to multiple receivers (broadcast mode or multicast mode) if no reply is expected, and if the ITS-SFS identified by an ITS-AID uses only a single transport layer port.

NOTE ITS-SUs that are not declared to be interoperable with IEEE WAVE devices can use TPID-FS one for dissemination of information (broadcasting of information).

7.2.8 TPID-FS one - general session mode

Support of TPID-FS one is mandatory. This "General Session Mode" is the default transport mode of operation for transmission of FNTP NPDUs to a single receiver (unicast mode) and to multiple receivers if a reply is expected. It is also used for transmission of FNTP NPDUs to multiple receivers if no reply is expected, and the related ITS-SFS has several receive ports.

7.2.9 TPID-FS two - LPP support mode

Support of TPID-FS two is optional.

7.2.10 T-Extensions

Table 2 presents currently identified T-Extensions.

Table 2 — T-Extensions

Name	Element ID	Comment
Packet Identifier	83	The "Packet Identifier" element is optionally included in the LM T-Header to identify uniquely a specific packet in a sequence of packets from a specific transmitter. A related procedure is not specified so far.

NOTE Support for resilience by FNTP (acknowledgement of messages) is being developed for a next version of this document. This support for resilience will likely require FNTP management PDUs with source / destination ITS-PNs set to the value zero. So far FNTP can support resilience by selecting the ISO 21218 IN_SAP service for acknowledged MAC frames.

7.2.11 FNTP body

The FNTP body field contains the "User Data" part of an ITS-FPDU specified in ISO 21217. The length of the "User Data" field expressed in multiples of octets is contained in the "Length of User Data" field of the T-Header.

7.3 Secure communications

FNTP NPDUs basically are not secured, as security means typically are assumed to be applied at the higher layers, e.g. ITS-S facilities layer or ITS-S applications.

Secured modes of operation may be identified in the future with either new subtypes or new TPID-FSs.

7.4 Protocol management elements

7.4.1 ITS-AID look-up table

In order to map well-known ITS-AID numbers used as destination address in T-Headers of TPID-FS zero to dynamically assigned ITS-PNs (PORT_DYN), or if available to well-known registered ITS-PNs (PORT_REG), the FNTP maintains respective look-up information. Assignments shall be done locally in ITS-SCUs with host role.

7.4.2 Service look-up table

The FNTP maintains look-up information as illustrated in Figure 2.

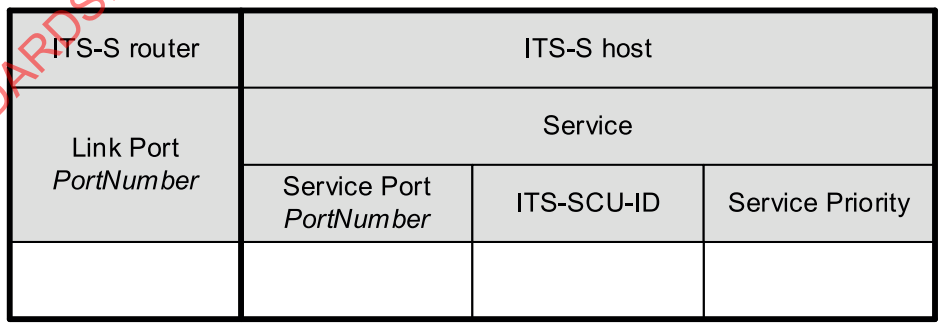

Figure 2 — Service look-up table

"Link Port" contains the ITS port number (ITS-PN) used in the FNTP T-Header in the link to a peer station, pointing indirectly to the ITS-SFS in the ITS-S host. "Service Port" contains the ITS-PN which points directly to the ITS-SFS in the ITS-S host. In case of dynamically assigned ITS-PNs, the allocation

of the Service Port ITS-PN is done in the ITS-SCU with host role, and the allocation of the Link Port ITS-PN is done in the ITS-SCU with router role that connects to the peer ITS-SCU.

NOTE The value in "Service Port" thus is not necessarily disclosed to the peer entity. In case ITS-S host and ITS-S router functionality is implemented in the same ITS-SCU, "Link Port" and "Service Port" can have the same value, and the look-up information becomes obsolete.

"ITS-SCU-ID" identifies the ITS-SCU of the ITS-S host where the ITS-SFS resides. "Service Priority" contains the maximum allowed user priority of the service.

This look-up information is part of the information contained in forwarding tables specified in 7.4.3.

7.4.3 Forwarding table

The FNTP maintains information as illustrated in Figure 3 needed to perform the protocol procedures specified in this document.

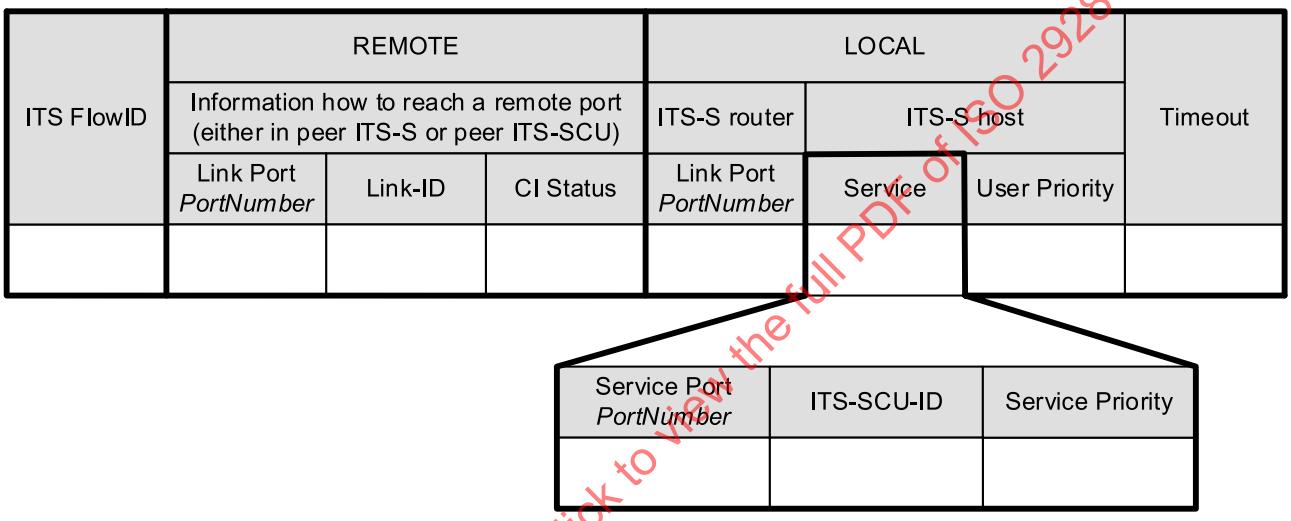

Figure 3 — Forwarding table

"ITS-S-FlowID" specified in ISO 24102-6 is a reference number for the settings given in the subsequent columns. If path and flow management specified in ISO 24102-6 is not supported, then the number in "ITS-S-FlowID" is just a unique sequential reference number without a specified usage.

The elements below "REMOTE" allow accessing an ITS-SFS in a peer ITS station or in a peer ITS-SCU of the same ITS-S.

— "Link Port" carries the port numbers as used in the communication link. A "Link Port" is unique only in combination with the corresponding "Link-ID".

— "Link-ID" specified in ISO 21218 carries the Link-ID of the VCI which connects to the peer entity via the communication link.

— "CI Status" carries the CI status specified in ISO 21218.

The elements below "LOCAL" allow accessing an ITS-SFS in the local entity.

— "Link Port" carries the port number as used in the link identifying the local ITS-SFS to be used for a potential reply by the peer station. A "Link Port" is unique only at the local ITS-SCU containing the ITS-S router functionality.

NOTE The two elements "Link Port" thus are the ITS-PNs contained in the Source Address and Destination Address fields of the T-Header for TPID-FS one and two as used in the link between peer entities (ITS-Ss or ITS-SCUs). For TPID-FS zero the Destination Address ITS-AID is mapped to a dynamically assigned ITS-PN, see 7.4.1.

— "Service" is as specified in 7.3.

— "Priority" carries the user priority as specified in ISO 21218 to be used for communications. The value of "Priority" for an unknown priority is zero. The maximum value of "Priority" is given in "Service Priority" of the service look-up table.

The elements in column "Timeout" contain time information on the validity of this entry. The value of "Timeout" is given by implementation.

8 General protocol procedures

8.1 Port management

A "Port management" illustrated in Figure 1 is in charge of

— uniquely assigning dynamic port numbers (PORT_DYN) to local ports;

— uniquely assigning dynamic port numbers (PORT_DYN) to locally known ITS-AIDs (ITS-AIDs used as destination address in FNTP NPDUs for TPID-FS zero);

— deleting previously assigned PORT_DYNs that are are no longer needed;

— mapping local ports to remote ports, see 7.4.

Further details on port management are specified in 8.2, 8.4, and 8.5.

8.2 Maintenance of entries in forwarding tables

The procedures to set, update, or delete an entry in an FNTP forwarding table depend on the implementation and on the role of the ITS-SCU.

Maintenance of a forwarding table may be performed partly

— by the FNTP itself, or

— by the ITS station management, either

  — locally (same ITS-SCU) or

  — locally and remotely (different ITS-SCUs in the same ITS-SU).

Remote maintenance of FNTP forwarding tables (between ITS-SCUs of the same ITS-SU) may be performed with ITS station-internal management communications, e.g. as specified in ISO 24102-4, if applicable.

8.3 Notification of changes in forwarding tables

Creation of an entry in a forwarding table by the FNTP shall be notified to the ITS-S management. An appropriate service primitive is MN-REQUEST {FWTnotify(`SetNotFNTP`)} specified in A.3, ISO 24102-1[5], and ISO 24102-3.

Update of an entry in a forwarding table by the FNTP shall be notified to the ITS-S management. AN appropriate service primitive is MN-REQUEST {FWTnotify(`UpdateNotFNTP`)} specified in A.3, ISO 24102-1[5], and ISO 24102-3.

Deletion of an entry in a forwarding table by the FNTP shall be notified to the ITS-S management. AN appropriate service primitive is MN-REQUEST {FWTnotify(`DeleteNotFNTP`)} of the MN-SAP specified in A.3, ISO 24102-1[5], and ISO 24102-3.

8.4 Initial settings of forwarding tables in ITS-S hosts

8.4.1 Allocation and deletion of a port

Upon registration of a port by means of the NF-FNTP-PORT service specified in 11.3, entries in the forwarding tables of the FNTP as presented in Figure 4 are created by the port management.

REMOTE			LOCAL			Timeout
Link Port	Link-ID	CI Status	ITS-S router Link Port	ITS-S Host Service (Port, ITS-SCU-ID, Priority)	Priority	
PORT_UNK	don't know		PORT_UNK	(of ITS-SFS)	of ITS-SFS	never (0)

Figure 4 — Forwarding table host - allocation of a port number by means of NF-FNTP-PORT

Upon deregistration of the port by means of the NF-FNTP-PORT service, all entries in the forwarding table related to this service are deleted.

8.4.2 Assignment of communication interfaces

The ITS station management creates entries in forwarding tables to indicate the status of communication interfaces. An appropriate service primitive is MN-COMMAND {FWTcommand(SetFNTP)} specified in Annex A, in ISO 24102-1[5], and in ISO 24102-3.

REMOTE			LOCAL			Timeout
Link Port	Link-ID	CI Status	ITS-S router Link Port	ITS-S Host Service (Port, ITS-SCU-ID, Priority)	Priority	
PORT_UNK	of CI / VCI	given status	PORT_UNK	don't know		never (0)

Figure 5 — Forwarding table host

8.5 Initial settings of forwarding tables in ITS-S routers

The ITS station management creates, updates, and deletes entries in forwarding tables to indicate the status of communication interfaces. Appropriate service primitives are

— MN-COMMAND {FWTcommand(SetFNTP)},

— MN-COMMAND {FWTcommand(UpdateFNTP)},

— MN-COMMAND {FWTcommand(DeleteFNTP)}

specified in A.3, ISO 24102-1[5], and ISO 24102-3.

The result of an initial creation of an entry is illustrated in Figure 6.

REMOTE			LOCAL			Timeout
Link Port	Link-ID	CI Status	ITS-S router Link Port	ITS-S Host Service (Port, ITS-SCU-ID, Priority)	Priority	
PORT_UNK	of CI / VCI	given status	PORT_UNK	don't know		never (0)

Figure 6 — Forwarding table router

8.6 CIP management

8.6.1 Purpose of CIPs and basic procedures

"Communication Interface Parameters" (CIPs) are defined for transmit parameters (TX-CIPs) and receive parameters (RX-CIPs). RX-CIPs and TX-CIPs may be contained in N-Extensions of FNTP-NPDUs, see Table 1.

TX-CIPs are used to request setting of transmit (TX) parameters of the VCI that connects to a peer ITS-SU prior to transmission of a packet, when CI or VCI parameters specified in ISO 21218 need to be changed on a packet-by-packet basis. TX-CIPs are reported to the VCI selected for transmission in parameter "access_parameters" of the selected IN-SAP service primitive (IN-UNITDATA.request or IN-UNITDATAACK.request) specified in ISO 21218.

In order to forward TX-CIPs to a peer ITS-SU, these are included as TX-CIP N-Extensions in the FNTP N-Header.

In receive mode notification of RX-CIPs related to receive (RX) parameter settings of the CI receiving FNTP NPDUs from peer ITS-SUs, if supported, are presented in parameter "access_parameters" of the IN-UNITDATA.indication service primitive specified in ISO 21218.

NOTE It is expected that CIP management is only done in ITS-S routers.

When setting of TX-CIPs or evaluation of RX-CIPs and TX-CIPs has to be done in ITS-S hosts, then forwarding of CIP information between ITS-S hosts and ITS-S routers is required.

TX-CIPs contained in an FNTP NPDU of subtype two, see 7.2.4, shall be removed after every single hop. New TX-CIPs may be added for a subsequent hop.

8.6.2 Forwarding of TX-CIPs from ITS-S host to ITS-S router

This procedure applies when an ITS-SCU with host role (source of an FNTP NPDU) wants setting of TX-CIPs in the ITS-SCU with router role that is selected for sending the FNTP NPDU to a peer ITS-SU.

The FNTP at the ITS-SCU with host role shall present TX-CIPs in the N-Extensions field of the FNTP N-Header, see Figure 7. When forwarding of the TX-CIPs to the peer ITS-SU is to be done, the TX-CIPs to be forwarded shall be presented similarly in the Original N-Header, i.e. the N-Header of the FNTP-NPDU to be transmitted by the ITS-SCU with router role to the peer ITS-SU.

N-Header								
4 bits	*1 bit*	*3 bits*	*1 octet*	*2 octets*	*16 octets*	*1 octet*	*Variable*	*variable*
Subtype = 1	N-Extensions flag = 1	Version	Direction	ITS-SCU-ID ITS-S host	Link-ID VCI in ITS-S router	Counter	N-Extensions (TX-CIPs)	Original N-Header

Figure 7 — Forwarding of TX-CIPs from ITS-S host to ITS-S router

The receiving ITS-SCU with router role in the same ITS station shall inspect the FNTP N-Header for TX-CIPs, and shall request transmission of the FNTP-NPDU to the peer ITS-SU applying TX-CIPs; see 9.4.2.

8.6.3 Forwarding of CIPs from ITS-S router to ITS-S host

Upon reception of an FNTP NPDU from a CI, the FNTP inspects parameter "access_parameters" of the IN-UNITDATA.indication service primitive for RX-CIPs, and makes these parameters available to the proper destination in the ITS-SCU with router role. Definition of such a destination is outside the scope of this document.

In case RX-CIP parameters of the own CI are present in parameter "access_parameters", the FNTP shall add these RX parameters as RX-CIP N-Extensions in the FNTP N-Header, see Figure 7.

At the ITS-SCU with host role, the FNTP removes the RX-CIP and TX-CIP N-Extensions from the NPDU, and shall make these CIPs available to the ITS-PN of the packet using the NF-FNTP-COMM.indication service primitive.

Usage of this CIP information is outside the scope of this document.

9 Transmitting packets procedures

9.1 General

The FNTP "TX procedure" for transmitting packets is illustrated in Figure 8 and specified in 9.2, 9.3, 9.4, and 9.5.

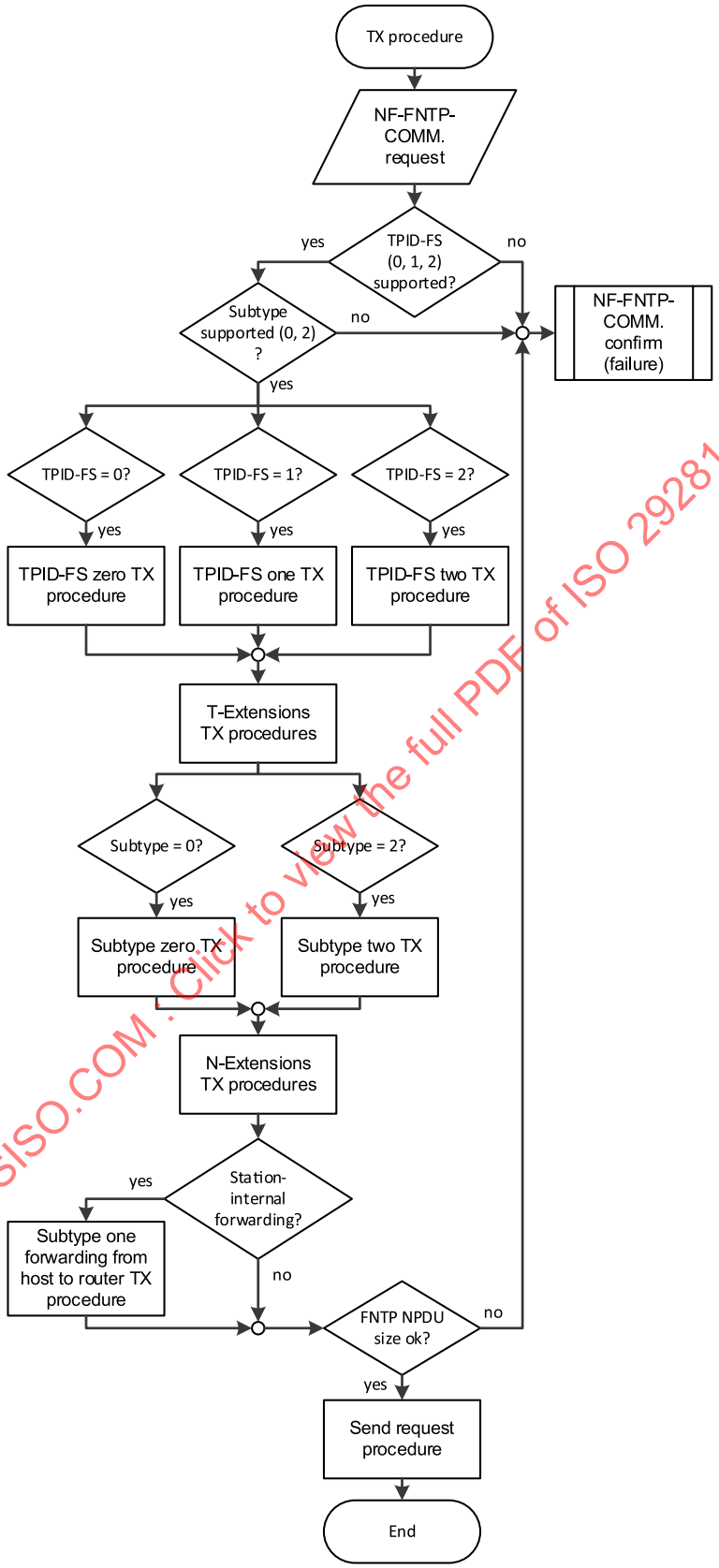

Figure 8 — FNTP TX procedure

9.2 NF-SAP transmission request

Upon a transmission request received via the NF-SAP by means of the service primitive NF-FNTP-COMM.request specified in 11.4.1, the FNTP may first check whether the forwarding table contains an entry in support of the transmission request.

— If no such entry exists, the transmission request may be discarded. If the transmission request is discarded, the FNTP shall notify failure of transmission by means of the service primitive NF-FNTP-COMM.confirm.

A valid entry in a forwarding table in support of a transmission request is given by a valid ITS-S-FlowID, or by:

— REMOTE ITS-S entries:

  — Valid Link Port,

  — CI Status allowing for transmission of a packet specified in ISO 21218, if known.

— LOCAL ITS-S entries:

  — Valid Link Port identifying the local ITS-PN for potential replies by the peer station.

  — Valid Service Port and valid ITS-SCU-ID identifying together uniquely an ITS-PN in the local ITS station.

NOTE LinkID and CI Status in REMOTE ITS-S can be checked. However FNTP trusts the decision of the ITS-S facilities layer or the ITS station management on which VCI to be used for transmission.

Without the need to discard the transmission request, the FNTP shall check whether the requested TPID-FS mode and the requested Subtype mode are supported.

— If the requested TPID-FS mode or the requested Subtype mode is not supported, the transmission request cannot be processed, and the FNTP shall notify failure of transmission by means of the service primitive NF-FNTP-COMM.confirm.

— Otherwise, the FNTP shall

  4) identify the appropriate TPID-FS mode and perform the related procedures to generate the FNTP NPDU except of the part depending on the applicable Subtype as specified in 9.3.1, 9.3.2, and 9.3.3;

  5) perform the "T-Extensions TX procedures" specified in 9.3.4, if applicable;

  6) identify the appropriate Subtype mode and perform the related procedures to finalize generation of the FNTP NPDU as specified in 9.4.1 and 9.4.3, except the support for a potentially necessary ITS station-internal forwarding;

  7) perform the "N-Extensions TX procedures" specified in 9.4.4, if applicable;

  8) if applicable, extend the FNTP NPDU for ITS station-internal forwarding to the appropriate ITS-SCU with router role that is selected to send the message to the intended peer ITS-SU as specified in 9.4.2.2;

  9) check the size of the resulting FNTP NPDU whether it fits to the capabilities of the CI to be used for transmission:

    — If the size exceeds the size constraint of the CI, the FNTP NPDU cannot be transmitted, and failure of transmission shall be notified by means of the service primitive NF-FNTP-COMM.confirm specified in 11.4.2;

    — otherwise the FNTP NPDU shall perform the "Send request procedure" specified in 9.5.

9.3 Transport related TX procedures

9.3.1 TPID-FS zero TX procedure

Applicability of the TPID-FS zero procedure is specified in 7.2.7.

The FNTP shall

— create the FNTP body with "User Data" equal to "data" given in the NF-FNTP-COMM.request service primitive;

— create the FNTP T-Header with

  — "Destination Address" equal to the ITS-AID corresponding to "remotePort" of the ITS-SFS in the peer ITS-SU that shall receive the message,

  — "Length of User Data" indicating the number of octets of the User Data in the FNTP body.

9.3.2 TPID-FS one TX procedure

Applicability of the TPID-FS one procedure is specified in 7.2.8.

The FNTP shall

— create the FNTP body with "User Data" equal to "data" given in the NF-FNTP-COMM.request service primitive;

— create the FNTP T-Header with

  — "Destination Address" equal to "remotePort" of the ITS-SFS in the peer ITS-SU that shall receive the message,

  — "Source Address" equal to "servicePort",

  — "Length of User Data" indicating the number of octets of the User Data in the FNTP body.

9.3.3 TPID-FS two TX procedure

The FNTP shall

— create the FNTP body with "User Data" equal to "data" given in the NF-FNTP-COMM.request service primitive;

— create the FNTP T-Header with

  — "Destination Address" equal to "remotePort" of the ITS-SFS in the peer ITS-SU that shall receive the message,

  — "Source Address" equal to "servicePort",

  — "Length of User Data" indicating the number of octets of the User Data in the FNTP body,

  — "LPP Header" extracted from "tpidTypeInfo".

9.3.4 T-Extensions TX procedures

9.3.4.1 General

When T-Extensions don't need to be added to the FNTP T-Header the FNTP shall

— set the T-Extensions flag to '0'b;

Otherwise the FNTP shall

— set the T-Extensions flag to '1'b;

— extract the T-Extensions from "tpidTypeInfo" in NF-FNTP-COMM.request;

— perform related local procedures, if applicable;

— install the T-Extensions in the FNTP T-Header;

9.3.4.2 Specific T-Extension TX procedure

NOTE So far no T-Extension procedure is specified.

9.4 Network related TX procedures

9.4.1 Subtype zero TX procedure

Applicability of the subtype zero procedure is specified in 7.2.2.

The FNTP shall

— complement the given FNTP T-Header and FNTP Body with the FNTP N-Header with "Subtype" set to zero, "Version" set to three, TPID-FS set to the applicable value.

9.4.2 Subtype one TX procedure

9.4.2.1 Applicability and general requirements

The subtype one TX procedures allow forwarding of FNTP NPDUs from an ITS-SCU with host role to an ITS-SCU with router role, and vice versa; see also 7.2.3.

The FNTP shall compare the ITS-SCU-ID in the service look-up table, which is the local ITS-SCU-ID, with the ITS-SCU-ID contained in the Link-ID presented in the NF-FNTP-COMM.request.

— If the two ITS-SCU-IDs are different, ITS station-internal forwarding is needed and the subtype one TX procedure specified in 9.4.2.2 shall be executed;

— otherwise no subtype one procedure is applicable.

The cyclic packet counter shall be incremented by one for every next station-internal forwarding. It shall wrap from its maximum possible value to zero. The counter value, together with the addresses "ITS-SCU-ID host" and "LINK-ID VCI" may be used to identify duplicate reception of a forwarded packet. Further details on the usage of the cyclic packet counter are outside the scope of this document.

9.4.2.2 Subtype one forwarding from host to router TX procedure

The FNTP shall

— extend the given "FNTP NPDU" N-Header (original N-Header) by the subtype one N-Header with "Subtype" set to one, "Version" set to three, indicating forwarding from ITS-S host to ITS-S router with "ITS-SCU-ID ITS-S host" indicating the private ITS-SCU-ID of the ITS-S host, "Link-ID of VCI in ITS-S router" indicating the Link-ID of the VCI in the ITS-S router used for transmission of the packet, the cyclic packet counter in "Counter" set to the next valid value, and "N-Extensions" set as required;

— perform the N-Extensions TX procedure for subtype one specified in 9.4.4, if applicable.

9.4.3 Subtype two TX procedure

9.4.3.1 Applicability

Applicability of the subtype one procedure is specified in 7.2.4.

9.4.3.2 Initial transmission

The FNTP shall

— complement the given FNTP T-Header and FNTP Body with the FNTP N-Header with "Subtype" set to two, "Version" set to three, "Message ID" set to a random number calculated by FNTP, "Hop Count" set to the applicable value, "TPID-FS" set to the applicable value.

Applicable values of "Hop Count" and "TPID-FS" are as requested in the NF-SAP service primitive NF-FNTP-COMM.request specified in 11.4.1.

9.4.3.3 N-hop Forwarding

The FNTP shall

— decrement "Hop Count" by one;

— if the hop count value is larger than zero, perform the "send request" procedure specified in 9.5 in order to request retransmission of the FNTP-NPDU to the same VCI as used for reception.

9.4.4 N-Extensions TX procedures

9.4.4.1 General

When N-Extensions don't need to be added to the FNTP N-Header, the FNTP shall set the "N-Extensions flag" to '0'b.

Otherwise the FNTP shall

— set the "N-Extensions flag" to '1'b;

— extract the N-Extensions from "subTypeInfo" in NF-FNTP-COMM.request;

— install the given N-Extensions in the "N-Extensions" field;

— perform related local N-Extension procedures, if applicable.

9.4.4.2 N-Extension "Transmit Power Used" TX procedure

This parameter of ASN.1 type `TXpower80211` is specified in IEEE 1609.3[17] for the WSMP. The corresponding medium-specific I-Parameter specified in ISO 21218 is TXpower. TXpower may be presented in "txCIP" in NF-FNTP-COMM.request.

No procedure for this N-Extension is specified. However the FNTP presents

— txCip in "access parameters" of the IN-UNITDATA.request service primitive.

9.4.4.3 N-Extension "Channel Number" TX procedure

This parameter of ASN.1 type `ChannelNumber80211` is specified in IEEE 1609.3[17] for the WSMP. The corresponding medium-specific I-Parameter specified in ISO 21218 is PhysicalChannelIds. PhysicalChannelIds may be presented in "txCIP" in NF-FNTP-COMM.request.

No procedure for this N-Extension is specified. However the FNTP presents

— txCip in "access parameters" of the IN-UNITDATA.request service primitive.

9.4.4.4 N-Extension "Data Rate" TX procedure

This parameter of ASN.1 type `DataRate80211` is specified in IEEE 1609.3[17] for the WSMP. The corresponding medium-specific I-Parameter specified in ISO 21218 is DataRate. DataRate may be presented in "txCIP" in NF-FNTP-COMM.request.

No procedure for this N-Extension is specified. However the FNTP presents

— txCip in "access parameters" of the IN-UNITDATA.request service primitive.

9.4.4.5 N-Extension "Channel Load" TX procedure

NOTE This N-Extension is not yet defined and no procedure is identified.

9.4.4.6 N-Extension "RX-CIP" TX procedure

This N-Extension is applicable only for subtype one, i.e. in case of ITS station-internal forwarding from an ITS-SCU with router role to an ITS-SCU with host role.

The FNTP shall

— create an RX-CIP N-Extension in the subtype one N-Header that contains the RX-CIPs reported in "access parameters" of the IN-UNITDATA.indication service primitive.

Details on how to enable RX-CIP management and forwarding between host and router ITS-SCUs are outside the scope of this document.

9.4.4.7 N-Extension "TX-CIP" TX procedure

No procedure is specified.

9.4.4.8 N-Extension "Channel busy ratio" TX procedure

NOTE No procedure is specified so far for this N-Extension.

9.5 Send request procedure

If MAC resilience is requested, the FNTP shall

— forward the "FNTP NPDU" to the proper VCI by means of the IN-UNITDATAACK.request service primitive specified in ISO 21218, with "source_address" indicating the CI to be used for transmission and "destination_address" containing "Link-ID" of VCI to be used for transmission, "data" equal to the "FNTP NPDU", "priority" as given by "Priority" in the forwarding table.

NOTE Resilience is specified in ISO 17423[1]. MAC resilience means that the MAC layer acknowledges received packets.

Otherwise, the FNTP shall

— forward the "FNTP NPDU" to the proper VCI by means of the IN-UNITDATA.request service primitive specified in ISO 21218, with "source_address" indicating the CI to be used for transmission and "destination_address" containing "Link-ID" of VCI to be used for transmission, "data" equal to the "FNTP NPDU", "priority" as given by "Priority" in the forwarding table.

The FNTP may

— notify success of transmission by means of the service primitive NF-FNTP-COMM.confirm specified in 11.4.2.

9.6 Subtype one forwarding from router to host TX procedure

The FNTP shall

— extend the given FNTP NPDU by the subtype one N-Header with "Subtype" set to one, "Version" set to three, indicating forwarding from ITS-S router to ITS-S host with "ITS-SCU-ID ITS-S host" indicating the private ITS-SCU-ID of the ITS-S host, "Link-ID of VCI in ITS-S router" indicating the Link-ID of the VCI in the ITS-S router used for reception of the packet, the cyclic packet counter in "Counter" set to the next valid value, and "N-Extensions" set as required;

— perform the "send request" procedure specified in 9.5 in order to send the extended FNTP NPDU to the ITS-SCU with host role for final processing.

10 Receiving packets procedures

10.1 General

The FNTP "RX procedure" for receiving packets is illustrated in Figure 9 and specified in 10.2, 10.3, and 10.4.

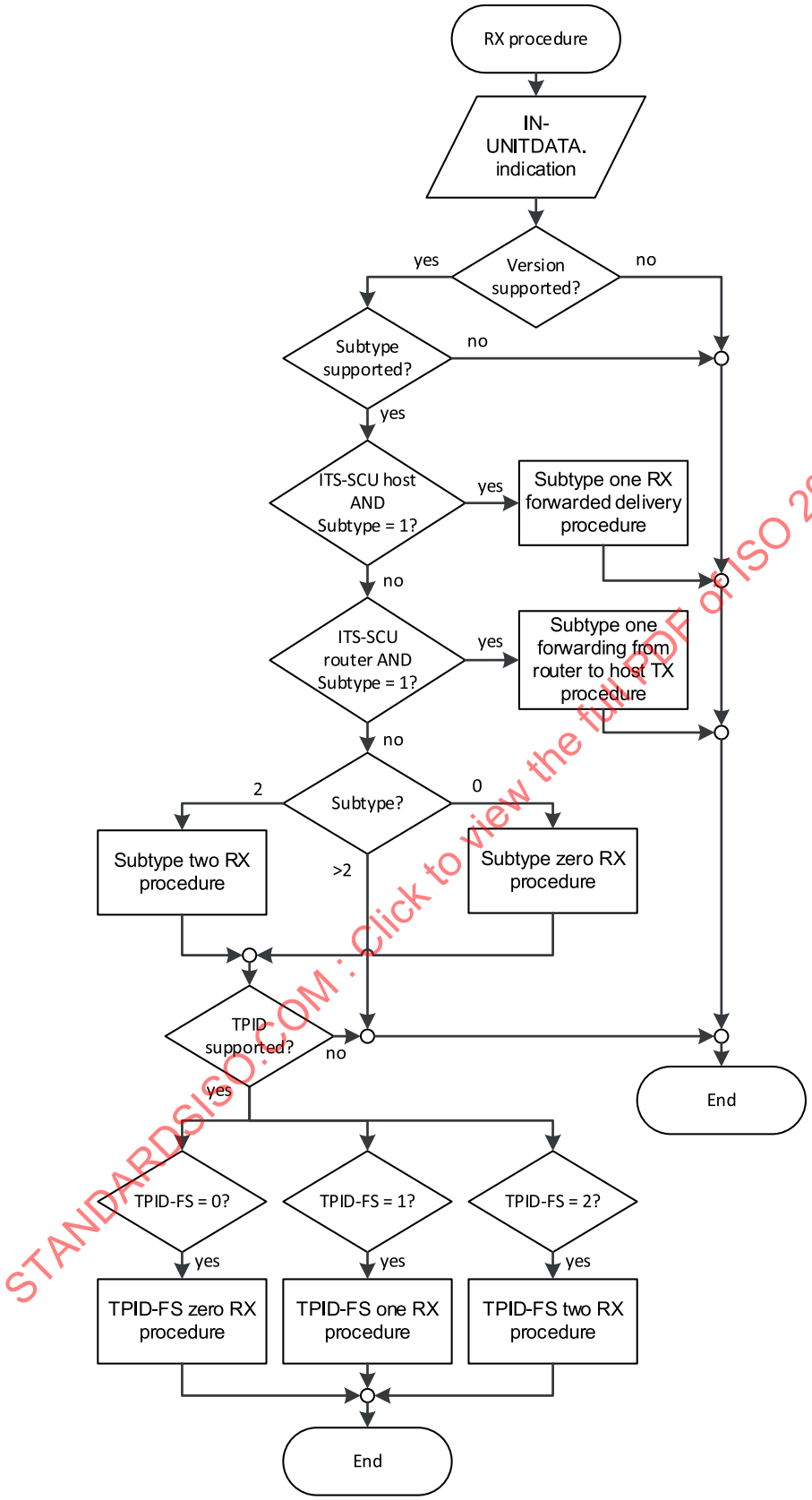

Figure 9 — FNTP RX procedure

10.2 Checking of FNTP N-Header

Upon reception of a data packet via the IN-SAP (IN-UNITDATA.indication) specified in ISO 21218, the FNTP shall first check the FNTP N-Header.

1) If the FNTP N-Header indicates a version of FNTP that is not supported, the FNTP cannot process the received packet.

2) If the FNTP N-Header indicates a subtype that is not supported, the FNTP cannot process the received packet.

3) If the FNTP N-Header indicates subtype one and the packet is received at an ITS-SCU with host role, the FNTP shall perform the "subtype one RX forwarded delivery procedure" specified in 10.3.2.1 and in 10.3.2.2.

4) If the FNTP N-Header indicates subtype one and the packet is received at an ITS-SCU with router role, the FNTP shall perform the "subtype one RX forwarded transmit procedure" specified in 10.3.2.1 and in 10.3.2.3.

5) If the FNTP N-Header indicates subtype zero, the FNTP shall perform the "subtype zero RX procedure" specified in 10.3.1.

6) If the FNTP N-Header indicates subtype two, the FNTP shall perform the "subtype two RX procedure" specified in 10.3.3.

7) The FNTP shall perform the "TPID-FS checking" procedure specified in 10.3.5.

10.3 Network related RX procedures

10.3.1 Subtype zero RX procedure

The FNTP shall

— perform procedures related to subtype zero N-Extensions specified in 10.3.4, if applicable.

10.3.2 Subtype one RX procedure

10.3.2.1 Applicability and general requirements

The subtype one RX procedure allows reception of FNTP NPDUs at an ITS-SCU with host role forwarded from an ITS-SCU with router role, and vice versa; see also 7.2.3.

The FNTP shall:

— check "ITS-SCU-ID".

If the value does not indicate the own ITS-SCU, the FNTP NPDU is addressed to another ITS-SCU, and the FNTP NPDU cannot be processed. Otherwise the FNTP shall

— check "Counter" in the T-Header.

If the same value previously was received, the given FNTP NPDU results from a repeated transmission and shall be discarded. Otherwise the FNTP shall

— perform procedures related to subtype one N-Extensions, if applicable;

— check "Direction" in the T-Header.

If the value is 255 (and the ITS-SCU has host role), the FNTP shall

— perform the "subtype one RX forwarded delivery procedure" specified in 10.3.2.2.

If the value is 0 (and the ITS-SCU has router role), the FNTP shall

— perform the "subtype one forwarding from host to router TX procedure" specified in 10.3.2.3.

If the value is different to 0 or 255 and the role-match is not given, the FNTP NPDU cannot be processed.

10.3.2.2 Subtype one RX forwarded delivery procedure

The FNTP shall

— note the "Link-ID VCI in ITS-S router" to update forwarding tables;

— remove the forwarding header and apply the "checking of FNTP N-Header procedure" specified in 10.1 for the remaining FNTP NPDU except for Subtype two re-transmissions, as these retransmissions are already performed at the ITS-SCU with router role that received the FNTP NPDU from a peer ITS-SU.

10.3.2.3 Subtype one RX forwarded transmit procedure

The FNTP shall

— perform the "N-Extensions TX procedures" for N-Extensions contained in the Subtype one N-Header;

— remove the forwarding header;

— apply the "send request procedure" specified in 9.5 for the remaining FNTP NPDU.

10.3.3 Subtype two RX procedure

The FNTP in an ITS-SCU with router role that received the FNTP NPDU from a peer ITS-SU shall

— perform the retransmission (N-Hop forwarding) procedure specified in 9.4.3.3.

The FNTP shall

— perform procedures related to subtype two N-Extensions specified in 10.3.4, if applicable;

— remove TX-CIP N-Extensions if applicable.

10.3.4 N-Extensions RX procedures

10.3.4.1 General

When known N-Extensions are contained in the received N-Header, these shall be processed accordingly as specified in 10.3.4.2, 10.3.4.3, 10.3.4.4, 10.3.4.5, 10.3.4.6, 10.3.4.7, and 10.3.4.8.

Unknown N-Extensions cannot be processed and are ignored.

10.3.4.2 N-Extension "Transmit Power Used" RX procedure

This parameter of ASN.1 type `TXpower80211` is specified in IEEE 1609.3[17] for the WSMP. The corresponding medium-specific I-Parameter specified in ISO 21218 is TXpower. The FNTP may

— use this TXpower in the same way as an RX-CIP parameter.

10.3.4.3 N-Extension "Channel Number" RX procedure

This parameter of ASN.1 type `ChannelNumber80211` is specified in IEEE 1609.3[17] for the WSMP. The corresponding medium-specific I-Parameter specified in ISO 21218 is PhysicalChannelIds. The FNTP may

— use this PhysicalChannelIds in the same way as an RX-CIP parameter.

10.3.4.4 N-Extension "Data Rate" RX procedure

This parameter of ASN.1 type `DataRate80211` is specified in IEEE 1609.3[17] for the WSMP. There is no corresponding medium-specific I-Parameter specified in ISO 21218.

No procedure applies.

10.3.4.5 N-Extension "Channel Load" RX procedure

This N-Extension is not yet fully specified.

No procedure applies.

10.3.4.6 N-Extension "RX-CIP" RX procedure

The CIP management procedure applies.

10.3.4.7 N-Extension "TX-CIP" RX procedure

The CIP management procedure applies.

10.3.4.8 N-Extension "Channel busy ratio" RX procedure

NOTE No procedure is specified so far for this N-Extension.

10.3.5 TPID-FS checking

1) If the FNTP T-Header indicates a TPID-FS that is not supported, the FNTP cannot process the received packet.

2) The FNTP shall perform the "ITS-SFS check and forwarding table update" procedure specified in 10.3.6.

3) If the FNTP T-Header indicates TPID-FS zero, the FNTP shall perform the "TPID-FS zero RX procedure" specified in 10.4.1.

4) If the FNTP T-Header indicates TPID-FS one, the FNTP shall perform the "TPID-FS one RX procedure" specified in 10.4.2.

5) If the FNTP T-Header indicates TPID-FS two, the FNTP shall perform the "TPID-FS two RX procedure" specified in 10.4.3.

10.3.6 ITS-SFS check and forwarding table update

The FNTP shall check the destination ITS-PN derived from the information contained in the "Destination Address" field of the FNTP T-Header. Note that in case of TPID-FS zero there is no "Source Address" available, and thus the related source ITS-PN is PORT_UNK.

— If the destination ITS-PN does not match any LOCAL Link Port associated with a "Service Port" entry in the service look-up table, the final ITS-SFS is not known.

In case the final ITS-SFS is known, the FNTP shall evaluate "Link-ID" contained in source_address provided in the service primitive of the IN-SAP.

— If "Link-ID" contained in source_address does not match any "Remote ITS-S - Link-ID" entry in the forwarding table and the "Source Address" ITS-PN is different from PORT_UNK (i.e. likely a reply is expected), an entry is created as presented in Figure 10.

REMOTE			LOCAL			Timeout
Link Port	**Link-ID**	**CI Status**	**ITS-S Router Link Port**	**ITS-S Host Service (Port, ITS-SCU-ID, Priority)**	**Priority**	
source Port	Link-ID contained in source_ address	connected	destination Port	entry from look-up table	optional update as provided by the access layer	never (0)

Figure 10 — Forwarding table - new entry upon reception of packet

— For every match in the forwarding table,

  — in case the "ITS-SCU-ID" indicates another ITS-SCU, the FNTP shall perform the forwarding from router to host TX procedure specified in 9.6;

  — otherwise the packet shall be further processed accordingly as specified in 10.3.5.

10.4 Transport related RX procedures

10.4.1 TPID-FS zero RX procedure

The FNTP shall

— check the T-Extensions if present and perform the related procedures specified in 10.4.4, if applicable;

— notify reception of the NPDU by means of the NF-FNTP-COMM.indication service primitive.

10.4.2 TPID-FS one RX procedure

The FNTP shall

— check the T-Extensions if present and perform the related procedures specified in 10.4.4, if applicable;

— notify reception of the NPDU by means of the NF-FNTP-COMM.indication service primitive.

10.4.3 TPID-FS two RX procedure

The FNTP shall

— check the T-Extensions if present and perform the related procedures specified in 10.4.4, if applicable;

— process the LPP header as specified in ISO 29281-2[8];

— notify reception of the NPDU by means of the NF-FNTP-COMM.indication service primitive in line with requirements set up in ISO 29281-2[8].

10.4.4 T-Extension RX procedures

10.4.4.1 General

When known T-Extensions are contained in the received T-Header, these shall be processed accordingly as specified in 10.4.4.2.

Unknown T-Extensions cannot be processed and are ignored.

10.4.4.2 Specific T-Extension RX procedure

NOTE No procedures are specified so far for T-Extension.

11 NF-SAP services

11.1 Overview

The FNTP shall provide the functionality of the service NF-FNTP-PORT of the NF-SAP with the service primitives

— NF-FNTP-PORT.request and

— NF-FNTP-PORT.confirm.

NF-FNTP-PORT.request is used by the ITS-S facilities layer to request allocation or deletion of a port number for a specific ITS-S facility application (ITS-SFS).

NF-FNTP-PORT.confirm provides a port number allowing the ITS-SFS to use the NF-FNTP-COMM service, and is used to report success or failure of an NF-FNTP-PORT.request.

The FNTP shall provide the functionality of the service NF-FNTP-COMM of the NF-SAP with the three service primitives

— NF-FNTP-COMM.request,

— NF-FNTP-COMM.confirm, and

— NF-FNTP-COMM.indication.

NF-FNTP-COMM.request is used by an ITS-SFS to request transmission of a data packet with the FNTP.

NF-FNTP-COMM.confirm is used by the FNTP to indicate success of failure of a previous NF-FNTP. COMM.request to an ITS-SFS.

NF-FNTP-COMM.indication is used by the FNTP to indicate reception of a data packet to an ITS-SFS.

11.2 General NF-SAP services

The mechanism for specifying NF-SAP service primitives is specified by means of ASN.1 types:

— The available set of request service primitives is identified with the ASN.1 type `NFsapRequestSPS`. A single request service primitive is of ASN.1 `NFsapRequest`.

— The available set of indication service primitives is identified with the ASN.1 type `NFsapIndicationSPS`. A single request service primitive is of ASN.1 `NFsapIndication`.

This mechanism is applicable for any kind of protocol using NF-SAP services, not just for FNTP.

The request service primitives and indication service primitives are part of the "dynamic data" identified in Clause 12.

11.3 NF-FNTP-PORT

11.3.1 NF-FNTP-PORT.request

The service primitive

```
FNTP-PORT.request    (
                     serviceRef,
                     operation,
                     port,
                     priority
                     )
```

of ASN.1 type `NFfntpPortRequest` specified in Annex A is used by the ITS-S facilities layer to request allocation or deletion of a port number associated with an ITS-SFS.

Parameter "serviceRef" of ASN.1 type ITS-`SapSId` specified in Annex A contains the identifier of the ITS-SFS.

Parameter "operation" of ASN.1 type `PortOp` specified in Annex A indicates creation or deletion of a port.

Parameter "port" of ASN.1 type `PortNumber` specified in Annex A contains either the value PORT_UNK in order to indicate dynamic assignment of a port number by the port management, or a valid value of a well-known static port PORT_REG.

Parameter "priority" of ASN.1 type `UserPriority` specified in Annex A contains the maximum applicable user priority of the ITS application object for the given port as specified in ISO 21218.

Upon reception of this service primitive, the FNTP shall perform the required operation given in "operation".

In order to allocate a port number, the FNTP port manager shall

— assign a locally valid port number which is unique in the ITS-SCU to the ITS-SP identified by "serviceRef", if parameter "port" is set to PORT_UNK, or shall use the presented well-known static port PORT_REG,

— create a new entry in the service look-up Table with "Service Port" equal to the port number assigned to this ITS-PN, "ITS-SCU-ID" equal to zero, "Service Priority" equal to "priority", "Link Port" set to PORT_UNK (unknown).

— issue an NF-FNTP-PORT.confirm service primitive as specified below,

— notify the result to the ITS station management.

NOTE 1 The ITS station management notifies other ITS-SCUs in the same ITS-SU about the action performed.

In order to delete a port number, the FNTP shall

— invalidate the related entries in the service look-up table,

— invalidate related entries in the forwarding table,

— issue an NF-FNTP-PORT.confirm service primitive as specified below,

— notify the result to the ITS station management.

NOTE 2 The ITS station management notifies other ITS-SCUs in the same ITS-SU about the action performed.

In case an ITS-SFS is no longer alive the related port number shall be deleted.

11.3.2 NF-FNTP-PORT.confirm

The service primitive

```
NF-FNTP-PORT.confirm        (
                serviceRef,
                servicePort
                )
```

of ASN.1 type `NFfntpPortConfirm` specified in Annex A is used by the FNTP to acknowledge a previous NF-FNTP-PORT.request.

Parameter "serviceRef" shall contain the same value provided in parameter "serviceRef" in the related NF-FNTP-PORT.request.

In case of successful allocation of a port number, parameter "servicePort" of ASN.1 type `PortNumber` specified in Annex A shall contain the Service port number assigned by the FNTP port manager.

Failure of allocating a port number shall be notified by assigning the value PORT_UNK to parameter "port".

Successful deletion of a port number shall be notified by assigning the value PORT_REG or PORT_DYN (the value of the deleted port) to parameter "port", as applicable.

11.4 NF-FNTP-COMM

11.4.1 NF-FNTP-COMM.request

The service primitive

```
NF-FNTP-COMM.request        (
                commRef,
                flowId (optional)
                flowParameters (optional)
                    servicePort,
                    remotePort,
                    linkID
                data,
                subTypeInfo,
                tpidTypeInfo,
                txCIP
                priority
                )
```

of ASN.1 type `NFfntpCommRequest`

specified in Annex A is used by the facilities layer to request transmission of a data packet using the FNTP.

Parameter "commRef" contains the value of a cyclic counter identifying this request. A value shall be assigned under the responsibility of the ITS-SFS.

At least either the component flowID of ASN.1 type `FlowID` specified in Annex A, or the component flowParameters of ASN.1 Type `FNTPflowParameters` specified in Annex A, contained in `FNTPflowInfo` shall be present.

Parameter "servicePort" of ASN.1 type `PortNumber` specified in Annex A identifies the local service port number (for usage in a reply - not supported in TPID-FS zero), as assigned at time of creation of the related association between the port number and the ITS-SFS.

Parameter "remotePort" of ASN.1 type `PortNumber` specified in Annex A indicates the destination port number, i.e. identify the peer ITS-SFS.

Parameter "linkID" of ASN.1 type `Link-ID` specified in Annex A shall identify the VCI to be used to transmit the packet, i.e. the peer station. Together with "remotePort", a unique identification of the peer ITS-SFS is achieved.

NOTE 1 Selection of communication interfaces (CI) for ITS-S application objects generally is done by the CI selection management specified in ISO 24102-1[5] or by the path and flow management specified in ISO 24102-6[8]. This also applies for ITS-S application objects which depend on a specific access technology, e.g. road safety applications. In any case, the parameter "linkID" allows overruling any decision previously made by the CI selection management.

NOTE 2 For multicast transmission via any possible CI, in `Link-ID` the component localCIID is set to the distinct null identifier (DNI), and the component remoteCIID is set to the broadcast identifier, see ISO 21218.

Parameter "priority" contains the applicable priority value for this transmission request.

Parameter "data" contains the ITS-SFS payload ITS-FPDU.

Parameter "subTypeInfo" of ASN.1 type `FNTPsubTypeInfo` specified in Annex A contains the subtype number and related parameters including N-Extensions, if applicable.

Parameter "tpidTypeInfo" of ASN.1 type `FNTPtpidInfo` specified in Annex A contains the TPID-FS and related parameters other than address information including T-Extensions, if applicable.

Parameter "txCIP" of ASN.1 type `TXcip` specified in Annex A shall contain communication interface parameters to be used for this transmission request.

This service primitive shall be generated ITS-SFS to request transmission of data to a peer station.

Upon reception of this service primitive, the FNTP shall create the FNTP NPDU and shall request transmission of the FNTP NPDU.

11.4.2 NF-FNTP-COMM.confirm

The service primitive

```
NF-FNTP-COMM.confirm        (
                commRef,
                flowId (optional)
                flowParameters (optional)
                    servicePort,
                    remotePort,
                    linkID
                errStatus
                )
```

of ASN.1 type `NFFntpCommConfirm` specified in Annex A is used by the FNTP to notify failure of a previous NF-FNTP-COMM.request. It may be used to notify success of a previous NF-FNTP-COMM. request.

The parameters "commRef", "flowId" and "flowParameters" shall have the same values as in the related NF-FNTP-COMM.request.

Success or failure shall be indicated with parameter "errStatus" as specified in Table 3.

Table 3 — NF-FNTP-COMM.confirm error status

Parameter ErrStatus"	Description
0: SUCCESS	success
1: UNSPECIFIED FAILURE	failure with unknown error code
2: CI BUSY FOR TX	packet cannot be delivered to the CI immediately
254: NO FORWARDING INFO	don't know where to deliver the packet
255: CI SUSPENDED	CI is currently in the state "suspended" as specified in ISO 21218

The usage of errStatus with a value different to zero indicating an error is not specified in this document.

11.4.3 NF-FNTP-COMM.indication

The service primitive

NF-FNTP-COMM.indication (
servicePort,
remotePort,
linkID,
priority,
data,
subtypeInfo,
tpidInfo
rxCIP
)

of ASN.1 type `NFfntpCommIndication` specified in Annex A is used by the FNTP to indicate to the ITS-S facilities layer reception of a packet for the ITS-SFS identified by the port number derived from the received destination address.

Parameter "servicePort" shall be set equal to the ITS-PN derived from the "Destination Address" field in the received NPDU.

Parameter "remotePort" shall be set equal to the ITS-PN derived from the "Source Address" field in the received NPDU.

Parameter "linkID" shall identify the VCI associated with the peer station.

Parameter "priority" shall contain the value as provided in the service primitive of the IN-SAP specified in ISO 21218.

Parameter "data" shall contain the ITS-FPDU provided by the peer service.

Parameter "subtypeInfo" shall contain the Subtype number and related parameters including N-Extensions as given in the received NPDU, if applicable.

Parameter "tpidInfo" of ASN.1 type `FNTPidInfo` specified in Annex A shall contain the TPID-FS and related parameters other than address information including T-Extensions as given in the received NPDU, if applicable.

Parameter "rxCIP" of ASN.1 type `RXcip` specified in Annex A shall contain local receive parameters related to this notification. Presence of parameter values is defined by the station management.

NOTE In case of ITS station-internal forwarding, receive parameters from the ITS-SCU with host role are reported in "subtypeInfo".

The service primitive shall be created upon successful reception and evaluation of a packet from a VCI.

12 Dynamic data

Dynamic data are data being registered at the ISO standards maintenance portal of this document[14], that may be specified in other standards based on generic definitions in this document, and will become part of this document to the extend the other standard applies for an implementation.

Dynamic data of FNTP are:

— NF-SAP request service primitives, see 11.2;

— NF-SAP indication service primitives, see 11.2.

Dynamic data of FNTP and the underlying ISO TS 16460 registered at the ISO standards maintenance portal of ISO/TS 16460[11], are:

— T-Extensions;

— N-Extensions;

— Subtypes;

— TPIDs.

13 Conformance

The "Protocol Implementation Conformance Statements" (PICS) proforma is provided in Annex C.

14 Test methods

The "Test Suite Structure & Test Purposes (TSS&TP) for conformance testing will be specified as a revision of [15].

The "Abstract Test Suite" (ATS) for conformance testing will be specified as a revision of [16].

Annex A
(normative)

ASN.1 modules

A.1 Overview

The ASN.1 basic notation is specified in ISO/IEC 8824-1[20]. The following ASN.1 module is specified in this Annex:

— **ITSfntp** { ISO (1) standard (0) calm-nonip (29281) fntp (1) asnm-1 (1) version2 (2)}

In case the ASN.1 specifications given in this Annex are not in accordance with illustrations or specifications provided elsewhere in this document, the specifications given in this Annex shall prevail.

A.2 Module ITSfntp

This module provides ASN.1 type definitions and ASN.1 value definitions.

Unaligned packed encoding rules (PER) as specified in ISO/IEC 8825-2 shall be applied for implementing FNTP.

In order to achieve octet alignment enabling cheap implementations, "fill" bits were defined. All fill bits shall be set to the value '0'b.

```
ITSfntp { iso (1) standard (0) calm-nonip(29281) fntp(1) asnm-1 (1) version2 (2)}

DEFINITIONS AUTOMATIC TAGS::=BEGIN

IMPORTS

UserPriority, NullType FROM CITSdataDictionary1 {iso(1) standard(0) cits-applMgmt (17419)
dataDictionary (1) version1 (1)}

ShortMsgData, LMnpdu, NoSubtypeProcessing, ShortMsgNextensions, NoTpidProcessing,
ShortMsgTextensions, LMhopCount FROM ITSlm1 { iso (1) standard (0) localized (16460) lm(1)
version1 (1)}

CIstatus, Link-ID, I-Param FROM ITSllsap {iso(1) standard(0) calm-ll-sap(21218) asnm-1 (1)
version2 (2)}

ITS-scuId, ITS-SapSsId, PortNumber FROM CITSapplMgmtApplReg2 {iso(1) standard(0)
cits-applMgmt (17419) applRegistry (2) version2 (2)}

FNTPIpp FROM CALMlegacySupport { iso (1) standard (0) calm-nonip(29281) legacy (2) asnm-1
(1) version2 (2)}

FlowID FROM ITSpfm { iso (1) standard (0) calm-management (24102) pfm (6) asnm-1 (1)
version2(2) }

;

-- End of IMPORTS

-- Types

-- FNTP NPDU --

FntpNpdu::=LMnpdu
```

```
-- Extension elements

RXcip::=SEQUENCE OF I-Param

TXcip::=SEQUENCE OF I-Param -- may optionally be forwarded to peer ITS station

-- NF-SAP --
-- General definitions for NF-SAP to be used also by other protocols
NFSAP ::= CLASS {
       &primitiveRef INTEGER (0..255),
       &Primitive
       }

NFsapRequest::=SEQUENCE{
       spRef  NFSAP.&primitiveRef ({NFsapRequestSps}),
       servPrimitive NFSAP.&Primitive({NFsapRequestSps}{@spRef})
       }

NFsapRequestSps NFSAP::={fntpPortRequest | fntpCommRequest, ...}

-- Definitions for NF-SAP dedicated to FNTP
fntpPortRequest     NFSAP::={&primitiveRef 0, &Primitive NFfntpPortRequest}
fntpCommRequest     NFSAP::={&primitiveRef 1, &Primitive NFfntpCommRequest}

-- General definitions for NF-SAP to be used also by other protocols
NFsapIndication::=SEQUENCE{
       spRef  NFSAP.&primitiveRef ({NFsapIndicationSps}),
       servPrimitive NFSAP.&Primitive({NFsapIndicationSps}{@spRef})
       }

NFsapIndicationSps NFSAP::={fntpPortConfirm | fntpCommConfirm | fntpCommIndication, ...}

-- Definitions for NF-SAP dedicated to FNTP
fntpPortConfirm      NFSAP::={&primitiveRef 0, &Primitive NFfntpPortConfirm}
fntpCommConfirm      NFSAP::={&primitiveRef 1, &Primitive NFfntpCommConfirm}
fntpCommIndication   NFSAP::={&primitiveRef 2, &Primitive NFfntpCommIndication}

NFfntpPortRequest::=SEQUENCE{
       serviceRef    ITS-SapSsId,
       operation     PortOp,
       portno PortNumber,
       priority      UserPriority
       }

PortOp::=INTEGER{
       delete (0),
       create (255)
       } (0..255)


NFfntpPortConfirm::=SEQUENCE{
       serviceRef    ITS-SapSsId,
       servicePort   PortNumber
       }

NFfntpCommRequest::=SEQUENCE{
       commRef       FNTPcommRef,
       flowInfo      FNTPflowInfo,
       data   ShortMsgData,
       subTypeInfo   FNTPsubTypeInfo,
       tpidInfo      FNTPtpidInfo,
       txCIP  TXcip,
       priority      UserPriority
       }

FNTPcommRef ::= INTEGER(0..127)

FNTPflowInfo ::= CHOICE{
       flowID  [0] FlowID,
       flowParameters [1] FNTPflowParameters
       }
```

```
FNTPflowParameters ::= SEQUENCE{
       servicePort   PortNumber,
       remotePort    PortNumber,
       linkID Link-ID
       }

FNTPsubTypeInfo ::=CHOICE{
       subtypeInfo0  [0] SubtypeInfo0,
       subtypeInfo1  [1] SubtypeInfo1,
       subtypeInfo2  [2] SubtypeInfo2,
       subtypeInfo3  [3] NoSubtypeProcessing,
       subtypeInfo4  [4] NoSubtypeProcessing,
       subtypeInfo5  [5] NoSubtypeProcessing,
       subtypeInfo6  [6] NoSubtypeProcessing,
       subtypeInfo7  [7] NoSubtypeProcessing,
       subtypeInfo8  [8] NoSubtypeProcessing,
       subtypeInfo9  [9] NoSubtypeProcessing,
       subtypeInfo10 [10] NoSubtypeProcessing,
       subtypeInfo11 [11] NoSubtypeProcessing,
       subtypeInfo12 [12] NoSubtypeProcessing,
       subtypeInfo13 [13] NoSubtypeProcessing,
       subtypeInfo14 [14] NoSubtypeProcessing,
       subtypeInfo15 [15] NoSubtypeProcessing
       }

SubtypeInfo0 ::= SEQUENCE {
       fill    BIT STRING (SIZE(3)), -- not used, set to '000'b
       extensions    ShortMsgNextensions OPTIONAL
       }

SubtypeInfo1 ::= SEQUENCE {
       fill    BIT STRING (SIZE(3)), -- not used, set to '000'b
       extensions    ShortMsgNextensions OPTIONAL
       }

SubtypeInfo2 ::= SEQUENCE{
       fill    BIT STRING (SIZE(1)), -- not used, set to '0'b
       hopCount      LMhopCount,
       nExtensions   ShortMsgNextensions OPTIONAL
       }

FNTPtpidInfo ::= CHOICE{
       tpdiInfo0     [0] TpidInfo0,
       tpdiInfo1     [1] TpidInfo1,
       tpidInfo2     [2] TpidInfo2,
       tpidInfo3     [3] NoTpidProcessing,
       tpidInfo4     [4] NoTpidProcessing,
       tpidInfo5     [5] NoTpidProcessing,
       tpidInfo6     [6] NoTpidProcessing,
       tpidInfo7     [7] NoTpidProcessing,
       tpidInfo8     [8] NoTpidProcessing,
       tpidInfo9     [9] NoTpidProcessing,
       tpidInfo10    [10] NoTpidProcessing,
       tpidInfo11    [11] NoTpidProcessing,
       tpidInfo12    [12] NoTpidProcessing,
       tpidInfo13    [13] NoTpidProcessing,
       tpidInfo14    [14] NoTpidProcessing,
       tpidInfo15    [15] NoTpidProcessing,
       tpidInfo16    [16] NoTpidProcessing,
       tpidInfo17    [17] NoTpidProcessing,
       tpidInfo18    [18] NoTpidProcessing,
       tpidInfo19    [19] NoTpidProcessing,
       tpidInfo20    [20] NoTpidProcessing,
       tpidInfo21    [21] NoTpidProcessing,
       tpidInfo22    [22] NoTpidProcessing,
       tpidInfo23    [23] NoTpidProcessing,
       tpidInfo24    [24] NoTpidProcessing,
       tpidInfo25    [25] NoTpidProcessing,
       tpidInfo26    [26] NoTpidProcessing,
       tpidInfo27    [27] NoTpidProcessing,
```

```
tpidInfo28    [28] NoTpidProcessing,
tpidInfo29    [29] NoTpidProcessing,
tpidInfo30    [30] NoTpidProcessing,
tpidInfo31    [31] NoTpidProcessing,
tpidInfo32    [32] NoTpidProcessing,
tpidInfo33    [33] NoTpidProcessing,
tpidInfo34    [34] NoTpidProcessing,
tpidInfo35    [35] NoTpidProcessing,
tpidInfo36    [36] NoTpidProcessing,
tpidInfo37    [37] NoTpidProcessing,
tpidInfo38    [38] NoTpidProcessing,
tpidInfo39    [39] NoTpidProcessing,
tpidInfo40    [40] NoTpidProcessing,
tpidInfo41    [41] NoTpidProcessing,
tpidInfo42    [42] NoTpidProcessing,
tpidInfo43    [43] NoTpidProcessing,
tpidInfo44    [44] NoTpidProcessing,
tpidInfo45    [45] NoTpidProcessing,
tpidInfo46    [46] NoTpidProcessing,
tpidInfo47    [47] NoTpidProcessing,
tpidInfo48    [48] NoTpidProcessing,
tpidInfo49    [49] NoTpidProcessing,
tpidInfo50    [50] NoTpidProcessing,
tpidInfo51    [51] NoTpidProcessing,
tpidInfo52    [52] NoTpidProcessing,
tpidInfo53    [53] NoTpidProcessing,
tpidInfo54    [54] NoTpidProcessing,
tpidInfo55    [55] NoTpidProcessing,
tpidInfo56    [56] NoTpidProcessing,
tpidInfo57    [57] NoTpidProcessing,
tpidInfo58    [58] NoTpidProcessing,
tpidInfo59    [59] NoTpidProcessing,
tpidInfo60    [60] NoTpidProcessing,
tpidInfo61    [61] NoTpidProcessing,
tpidInfo62    [62] NoTpidProcessing,
tpidInfo63    [63] NoTpidProcessing,
tpidInfo64    [64] NoTpidProcessing,
tpidInfo65    [65] NoTpidProcessing,
tpidInfo66    [66] NoTpidProcessing,
tpidInfo67    [67] NoTpidProcessing,
tpidInfo68    [68] NoTpidProcessing,
tpidInfo69    [69] NoTpidProcessing,
tpidInfo70    [70] NoTpidProcessing,
tpidInfo71    [71] NoTpidProcessing,
tpidInfo72    [72] NoTpidProcessing,
tpidInfo73    [73] NoTpidProcessing,
tpidInfo74    [74] NoTpidProcessing,
tpidInfo75    [75] NoTpidProcessing,
tpidInfo76    [76] NoTpidProcessing,
tpidInfo77    [77] NoTpidProcessing,
tpidInfo78    [78] NoTpidProcessing,
tpidInfo79    [79] NoTpidProcessing,
tpidInfo80    [80] NoTpidProcessing,
tpidInfo81    [81] NoTpidProcessing,
tpidInfo82    [82] NoTpidProcessing,
tpidInfo83    [83] NoTpidProcessing,
tpidInfo84    [84] NoTpidProcessing,
tpidInfo85    [85] NoTpidProcessing,
tpidInfo86    [86] NoTpidProcessing,
tpidInfo87    [87] NoTpidProcessing,
tpidInfo88    [88] NoTpidProcessing,
tpidInfo89    [89] NoTpidProcessing,
tpidInfo90    [90] NoTpidProcessing,
tpidInfo91    [91] NoTpidProcessing,
tpidInfo92    [92] NoTpidProcessing,
tpidInfo93    [93] NoTpidProcessing,
tpidInfo94    [94] NoTpidProcessing,
tpidInfo95    [95] NoTpidProcessing,
tpidInfo96    [96] NoTpidProcessing,
tpidInfo97    [97] NoTpidProcessing,
tpidInfo98    [98] NoTpidProcessing,
```

```
        tpidInfo99    [99] NoTpidProcessing,
        tpidInfo100   [100] NoTpidProcessing,
        tpidInfo101   [101] NoTpidProcessing,
        tpidInfo102   [102] NoTpidProcessing,
        tpidInfo103   [103] NoTpidProcessing,
        tpidInfo104   [104] NoTpidProcessing,
        tpidInfo105   [105] NoTpidProcessing,
        tpidInfo106   [106] NoTpidProcessing,
        tpidInfo107   [107] NoTpidProcessing,
        tpidInfo108   [108] NoTpidProcessing,
        tpidInfo109   [109] NoTpidProcessing,
        tpidInfo110   [110] NoTpidProcessing,
        tpidInfo111   [111] NoTpidProcessing,
        tpidInfo112   [112] NoTpidProcessing,
        tpidInfo113   [113] NoTpidProcessing,
        tpidInfo114   [114] NoTpidProcessing,
        tpidInfo115   [115] NoTpidProcessing,
        tpidInfo116   [116] NoTpidProcessing,
        tpidInfo117   [117] NoTpidProcessing,
        tpidInfo118   [118] NoTpidProcessing,
        tpidInfo119   [119] NoTpidProcessing,
        tpidInfo120   [120] NoTpidProcessing,
        tpidInfo121   [121] NoTpidProcessing,
        tpidInfo122   [122] NoTpidProcessing,
        tpidInfo123   [123] NoTpidProcessing,
        tpidInfo124   [124] NoTpidProcessing,
        tpidInfo125   [125] NoTpidProcessing,
        tpidInfo126   [126] NoTpidProcessing,
        tpidInfo127   [127] NoTpidProcessing
        }

TpidInfo0 ::= SEQUENCE{
        extensions    ShortMsgTextensions OPTIONAL
        }

TpidInfo1 ::= SEQUENCE{
        extensions    ShortMsgTextensions OPTIONAL
        }

TpidInfo2 ::= SEQUENCE{
        lpp    FNTPlpp,
        tExtensions   ShortMsgTextensions OPTIONAL
        }

NFfntpCommConfirm::=SEQUENCE{
        commRef       FNTPcommRef,
        flowInfo      FNTPflowInfo,
        errStatus     FNTPerrorStatus
        }

FNTPerrorStatus::=INTEGER{
        success       (0),
        unspecFailure (1),
        ciBusyTX      (2),
        noForwardInfo (254),
        ciSuspend     (255)
        } (0..255)

NFfntpCommIndication::=SEQUENCE{
        servicePort   PortNumber,
        remotePort    PortNumber,
        linkID Link-ID,
        priority      UserPriority,
        data   PortNumber,
        subTypeInfo   FNTPsubTypeInfo,
        tpidInfo      FNTPtpidInfo,
        rxCIP  RXcip
        }

-- MN-SAP
```

```
DeleteFNTP::=SEQUENCE{
       reference     FntpFwtReference
       }

FntpFwtReference ::= INTEGER(0..noFNTPfwtEntries)

DeleteConfFNTP::=NullType

DeleteNotFNTP::=SEQUENCE{
       reference     FntpFwtReference
       }

SetFNTP::=SEQUENCE{
       remotePort    PortNumber,
       linkID Link-ID,
       ciStatus      CIstatus,
       linkPort      PortNumber,
       serviceInfo   HostServiceInfo, --formerly ServiceNWref
       priority      UserPriority,
       timeout       NTtimeout
       } -- SetConfFNTP returns the reference pointing to the new entry.

SetConfFNTP::=SEQUENCE{
       reference     FntpFwtReference
       }

HostServiceInfo::=SEQUENCE{
       servicePort   PortNumber,
       hostITSscu    ITS-scuId,
       servicePriority     UserPriority
       }

NTtimeout::=INTEGER{
       c-NTto-never  (0)
       }(0..65535) -- in milli seconds

SetNotFNTP::=SEQUENCE{
       reference     FntpFwtReference,
       remotePort    PortNumber,
       linkID Link-ID,
       ciStatus      CIstatus,
       linkPort      PortNumber,
       serviceInfo   HostServiceInfo,
       priority      UserPriority,
       timeout       NTtimeout
       }

UpdateFNTP::=SEQUENCE{
       fill    BIT STRING (SIZE(1)),  -- set to '0'b
       reference     FntpFwtReference,
       remotePort    PortNumber OPTIONAL,
       linkID Link-ID OPTIONAL,
       ciStatus      CIstatus OPTIONAL,
       linkPort      PortNumber OPTIONAL,
       serviceInfo   HostServiceInfo OPTIONAL,
       priority      UserPriority OPTIONAL,
       timeout       NTtimeout OPTIONAL
       }

UpdateConfFNTP::=NullType

UpdateNotFNTP::=SEQUENCE{
       fill    BIT STRING (SIZE(1)), -- set to '0'b
       reference     FntpFwtReference,
       remotePort    PortNumber OPTIONAL,
       linkID Link-ID OPTIONAL,
       ciStatus      CIstatus OPTIONAL,
       linkPort      PortNumber OPTIONAL,
       serviceInfo   HostServiceInfo OPTIONAL,
       priority      UserPriority OPTIONAL,
       timeout       NTtimeout OPTIONAL
```

```
        }

-- Values

noFNTPfwtEntries     INTEGER::=65535


/*
   The ASN.1 specification has been checked for conformance to the ASN.1
   standards by OSS ASN.1 Syntax Checker, and by OSS ASN-1STEP
*/

END
```

A.3 Definitions to be added to ISO 24102-1

A.3.1 General

This document specifies dynamic extensions of general types that are defined in ISO 24102-1 with the ASN.1 type CLASS. Up-to-date versions of the various ASN.1 modules from ISO 24102-1 including all dynamic updates are published at [13].

A.3.2 ASN.1 module ITSmanagement

IMPORT statement to be added:

```
SetFNTP, UpdateFNTP, DeleteFNTP, SetConfFNTP, UpdateConfFNTP, DeleteConfFNTP, SetNotFNTP,
UpdateNotFNTP, DeleteNotFNTP FROM ITSfntp { iso (1) standard (0) calm-nonip(29281) fntp(1)
asnm-1 (1) version2 (2)}
```

The following ASN.1 value definitions (values 'a', 'b', 'c') will be completed by ISO TC204 WG16. The result will be published in the respective ISO registry[12].

```
c-fntpSet     RefFWT ::= <'a' tbd>
c-fntpUpdate  RefFWT ::= <'b' tbd>
c-fntpDelete  RefFWT ::= <'c' tbd>
```

To be added to FwtCommands:

```
fntpset       FWT::={&fwtRef c-fntpSet, &Fwt SetFNTP}
fntpupdate    FWT::={&fwtRef c-fntpUpdate, &Fwt UpdateFNTP}
fntpdelete    FWT::={&fwtRef c-fntpDelete, &Fwt DeleteFNTP}
```

To be added to FwtCommandsConf:

```
fntpsetConf          FWTCONF::={&fwtRef c-fntpSet, &Fwt SetConfFNTP}
fntpupdateConf       FWTCONF::={&fwtRef c-fntpUpdate, &Fwt UpdateConfFNTP}
fntpdeleteConf       FWTCONF::={&fwtRef c-fntpDelete, &Fwt DeleteConfFNTP}
```

Annex B
(informative)

ASN.1 modules from ISO 16460

B.1 General

Since the time of publication of ISO TS 16460, the following four ASN.1 modules

1) CALMfntp { iso (1) standard (0) calm-nonip(29281) fntp(1) asnm-1 (1) version1 (1)} from ISO 29281-1;

2) CALMllsap {iso(1) standard(0) calm-ll-sap(21218) asnm-1 (1) version1 (1)} from ISO 21218;

3) CALMmanagement { iso (1) standard (0) calm-management (24102) local (1) asnm-1 (1) version1 (1)} from ISO 24102-1;

4) CITSapplMgmtIDs {iso(1) standard(0) cits-applMgmt (17419) ids (1) version1 (1)} from ISO 17419.

from which ASN.1 type definitions are imported into

— ITSlm { iso (1) standard (0) localized (16460) lm(1) version0 (0)}

and

— ITSee { iso (1) standard (0) localized(16460) ee(4) version0 (0)}

specified in ISO TS 16460, were changed towards the versions used in the set of C-ITS Release 2 standards.

Consequently, the related IMPORT clauses preferably are changed as presented in B.2 and B.3. These changes do not affect the interoperability mode with WSMP, as the changes are only editorial with respect of the encoded messages.

These changes will have to be implemented in the next version of ISO TS 16460.

B.2 ITSlm

Change

— `RXcip, TXcip FROM CALMfntp { iso (1) standard (0) calm-nonip(29281) fntp(1) asnm-1 (1) version1 (1)}`

to

— `RXcip, TXcip FROM ITSfntp { iso (1) standard (0) calm-nonip(29281) fntp(1) asnm-1 (1) version2 (2)}`

Change

— `FNTPlpp FROM CALMlegacySupport { iso (1) standard (0) calm-nonip(29281) legacy (2) asnm-1 (1) version1 (1)}`

to

— `FNTPlpp FROM ITSlegacySupport { iso (1) standard (0) calm-nonip(29281) legacy (2) asnm-1 (1) version2 (2)}`

Change

— `Link-ID FROM CALMllsap {iso(1) standard(0) calm-ll-sap(21218) asnm-1 (1) version1 (1)}`

to

— `Link-ID FROM ITSllsap {iso(1) standard(0) calm-ll-sap(21218) asnm-1 (1) version2 (2)}`

Change

— `ITS-scuId FROM CALMmanagement { iso (1) standard (0) calm-management (24102) local (1) asnm-1 (1) version1 (1)}`

to

— `ITS-scuId FROM ITSmanagement { iso (1) standard (0) calm-management (24102) local (1) asnm-1 (1) version2 (2)}`

Change

— `VarLengthNumber, VarLengthNumber2 FROM CITSapplMgmtIDs {iso(1) standard(0) cits-applMgmt (17419) ids (1) version1 (1)}`

to

— `VarLengthNumber, VarLengthNumber2 FROM CITSdataDictionary1 {iso(1) standard(0) cits-applMgmt (17419) dataDictionary (1) version1 (1)}`

B.3 ITSee

Change

— `MedType FROM CALMllsap {iso(1) standard(0) calm-ll-sap(21218) asnm-1 (1) version1 (1)}`

to

— `ITSatt FROM CITSapplMgmtApplReg {iso(1) standard(0) cits-applMgmt (17419) applRegistry (2) version2 (2)}`

and add the type definition

```
MedType ::= ITSatt.
```

Annex C
(normative)

Protocol Implementation Conformance Statement proforma

C.1 Guidance for completing the PICS proforma

C.1.1 Purposes and structure

The purpose of this PICS proforma is to provide a mechanism whereby a supplier of an implementation of the requirements defined in this document may provide information about the implementation in a standardized manner.

The PICS proforma is subdivided into clauses for the following categories of information:

— guidance for completing the PICS proforma;

— identification of the implementation;

— identification of the implementation;

— global statement of conformance.

C.1.2 Abbreviations and conventions

The PICS proforma contained in this annex is comprised of information in tabular form in accordance with the guidelines presented in ISO/IEC 9646-7[19].

Item column	The item column contains a number which identifies the item in the table.
Item description column	The item description column describes in free text each respective item (e.g. parameters).
Status column	The notations defined in ISO/IEC 9646-7[19] are used for the status column: m mandatory - the capability is required to be supported. o optional - the capability may be supported or not. n/a not applicable - in the given context, it is impossible to use the capability. x prohibited (excluded) - there is a requirement not to use this capability in the given context. o.i qualified optional - for mutually exclusive or selectable options from a set. "i" is an integer which identifies an unique group of related optional items and the logic of their selection which is defined immediately following the table. ci conditional - the requirement on the capability ("m", "o", "x" or "n/a") depends on the support of other optional or conditional items. "i" is a string containing the respective Table number followed by a sequential number identifying a unique conditional status expression which is defined immediately following the respective Table.
Reference column	The reference column makes reference to this document, except where explicitly stated otherwise.

Support column	The support column shall be filled in by the supplier of the implementation. The following common notations, defined in ISO/IEC 9646-7[19], are used for the support column: Y or y supported by the implementation. N or n not supported by the implementation. N/A, n/a, or no answer required (allowed only if the status is n/a, directly or after evaluation of a conditional status).
Values allowed column	The values allowed column contains the type, the list, the range, or the length of values allowed. The following notations are used: — range of values: <min value> .. <max value> — list of values: <value1>, <value2>, ..., <valueN> — list of named values: <name1>(<val1>), <name2>(<val2>), ..., <nameN>(<valN>) — length: size (<min size> .. <max size>)
Values supported column	The values supported column shall be filled in by the supplier of the implementation. In this column, the values or the ranges of values supported by the implementation shall be indicated.
References to items	For each possible item answer (answer in the support column) within the PICS proforma a unique reference exists, used, for example, in the conditional expressions. It is defined as the table identifier, followed by a solidus character "/", followed by the item number in the table. If there is more than one support column in a table, the columns are discriminated by letters (a, b, etc.), respectively.
Prerequisite line	A prerequisite line takes the form: Prerequisite: <predicate>. A prerequisite line after a clause or table title indicates that the whole clause or the whole table is not required to be completed if the predicate is FALSE.

C.1.3 Instructions for completing the PICS proforma

The supplier of the implementation shall complete the PICS proforma. In particular, an explicit answer shall be entered using the notation described in C.1.2.

C.2 Identification of the Implementation

Identification of the Implementation Under Test (IUT) and the system in which it resides, i.e. the System Under Test (SUT), shall be filled in so as to provide as much detail as possible regarding version numbers and configuration options.

The product supplier information and client information shall both be filled in if they are different.

A person who can answer queries regarding information supplied in the PICS shall be named as the contact person.

C.2.1 Date of the statement