BS ISO 29281-1:2013

BSI Standards Publication

Intelligent transport systems — Communication access for land mobiles (CALM) — Non-IP networking

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

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National foreword

This British Standard is the UK implementation of ISO 29281-1:2013. Together with BS ISO 29281-2:2013, it supersedes BS ISO 29281:2011 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EPL/278, Road transport informatics.

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INTERNATIONAL STANDARD

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First edition
2013-04-15

Intelligent transport systems — Communication access for land mobiles (CALM) — Non-IP networking —

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

Systèmes intelligents de transport — Accès aux communications des services mobiles terrestres (CALM) — Réseautique non-IP —

Partie 1: Réseautique rapide et protocole de la couche transport

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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. www.iso.org/directives

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The committee responsible for this document is ISO/TC 204, *Intelligent transport systems*.

This first edition of ISO 29281-1, together with ISO 29281-2, cancels and replaces ISO 29281:2011.

ISO 29281 consists of the following parts, under the general title *Intelligent transport systems — Communication access for land mobiles (CALM) — Non-IP networking*:

— *Part 1: Fast networking and transport layer protocol (FNTP)*

— *Part 2: Legacy system support*

Introduction

This part of ISO 29281 is part of a series of International Standards for communications access for land mobiles (CALM). An introduction to the whole set of International Standards is provided in ISO 21217.

This part of ISO 29281 is part 1 of a multipart standard which determines the intelligent transport systems (ITS) non-IP communications.

An essential protocol for non-IP communications is the “Fast networking & transport layer protocol” (FNTP). FNTP distinguishes:

— a basic port mapper protocol, primarily used for single-hop communications between ITS stations;

— protocol extensions for

  — N-hop groupcast;

  — LPP;

  — secured communication;

  — ITS station-internal forwarding of packets between ITS-S host ITS-SCUs and ITS-S router ITS-SCUs.

FNTP is validated in the CVIS project.

INTERNATIONAL STANDARD **ISO 29281-1:2013(E)**

Intelligent transport systems — Communication access for land mobiles (CALM) — Non-IP networking —

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

1 Scope

This part of ISO 29281 specifies a protocol of the ITS-S networking and transport layer in support of efficient ad hoc single-hop communications with optional N-hop broadcast.

This protocol supports ITS station-internal forwarding of packets, i.e. between ITS-S routers and ITS-S hosts and vice versa. The protocol is named "Fast Networking & Transport Protocol" (FNTP).

2 Normative references

The following referenced documents are indispensable for the application 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 21217, *Intelligent transport systems — Communications access for land mobiles (CALM) — Architecture*

ISO 21218, *Intelligent transport systems — Communications access for land mobiles (CALM) — Access technology support*

ISO 24102-1, *Intelligent transport systems — Communications access for land mobiles (CALM) — ITS station management — Part 1: Local management*

ISO 24102-3, *Intelligent transport systems — Communications access for land mobiles (CALM) — ITS station management — Part 3: Service access points*

ISO 24102-4, *Intelligent transport systems — Communications access for land mobiles (CALM) — ITS station management — Part 4: Station-internal management communications*

ISO 24102-5, *Intelligent transport systems — Communications access for land mobiles (CALM) — ITS station management — Part 5: Fast service advertisement protocol (FSAP)*

ETSI TS 102 985-1, *Intelligent Transport Systems (ITS); Communications Access for Land Mobiles (CALM); Test specifications for non-IP networking (ISO 29281); Part 1: Protocol implementation conformance "statement (PICS) proforma*

ETSI TS 102 985-2, *Intelligent Transport Systems (ITS); Communications Access for Land Mobiles (CALM); Test specifications for non-IP networking (ISO 29281); Part 2: Test suite structure & test purposes (TSS&TP)*

ETSI TS 102 985-3, *Intelligent Transport Systems (ITS); Communications Access for Land Mobiles (CALM); Test specifications for non-IP networking (ISO 29281); Part 3: Abstract test suite and partial PIXIT (ATS) specification*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21217, ISO 24102-3, ISO 24102-4 and the following apply.

3.1
ITS-S port
source and/or destination "endpoint" for communications identified by an integer number

4 Abbreviated terms

FNTP Fast networking & transport protocol

ITS-SP ITS-S port

5 Architectures

5.1 Modes of operation

5.1.1 General context and purpose of FNTP

The "fast networking & transport layer protocol" (FNTP) specified in this part of ISO 29281 is designed as a protocol of the ITS-S networking and transport layer of the ITS station (ITS-S) architecture which recognizes the concepts of the bounded, secured and managed ITS-S; and supports the concept of ITS station communication units (ITS-SCU) to implement roles of an ITS-S in physical units specified (see ISO 21217, ISO 24102-1, ISO 24102-3 and ISO 24102-4).

FNTP is primarily designed to enable single-hop communication between peer ITS stations with minimum protocol overhead, and supports optional features.

NOTE ISO 15628 legacy systems support specified in [2] makes use of FNTP.

FNTP supports any kind of ad hoc access technology, e.g. CALM M5, CALM IR. FNTP may be used to connect source and destination "endpoints" identified by "ITS-S port" (ITS-SP) numbers in peer ITS stations, where peer ITS stations are uniquely identified by a Link-ID (usually MAC address contained in it) of the access layer specified in ISO 21218. Consequently, FNTP is a port mapper protocol, usually located in the transport layer of the OSI model.

5.1.2 Basic mode of operation

The basic mode of operation is the simplest option of FNTP, which is just providing single-hop communications between instances of ITS stations without applying any of the options of FNTP.

5.1.3 Extended mode of operation

The extended mode of operation supports options of the FNTP, e.g.:

— ITS station-internal forwarding;

— secure communications;

— N-hop broadcast;

— LPP support;

— CIP management.

ITS station-internal forwarding is a special option referred to as “station-internal forwarding mode of operation”.

Other options may be added in a future revision of this part of ISO 29281.

5.2 FNTP reference architecture

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

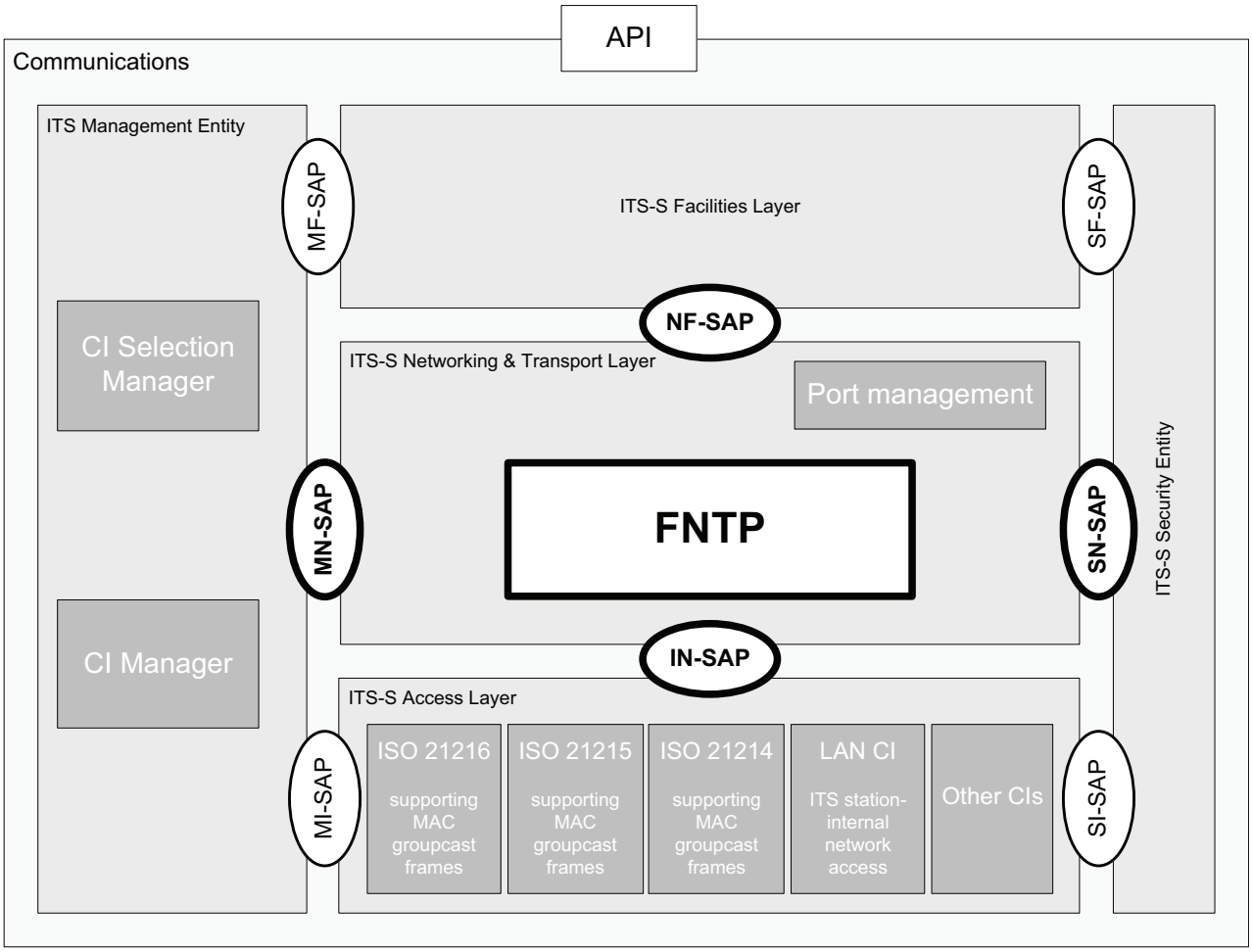

Figure 1 — FNTP reference architecture

The “Port management” is specified as part of FNTP, but may also be used for other ITS-S networking and transport layer protocols.

The “CI Selection Manager” is specified in ISO 24102-1. The “CI Manager” is specified in ISO 24102-1 and ISO 21218. These two managers are supporting FNTP, but FNTP does not necessarily depend on these managers.

5.3 Communication principles

5.3.1 Transmission

Transmission requests may be presented by the ITS-S facilities layer via the NF-SAP. Sources and destinations of messages in the ITS-S facilities layer are identified by ITS-SP numbers.

Valid transmission requests to a groupcast MAC address are given by a "well-known" destination port address in combination with an existing groupcast VCI. The value of the source port address 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.

Valid transmission requests to a unicast MAC address are given by any valid destination port address in combination with an existing unicast VCI. The value of the source port address 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.

NOTE In a CALM compliant ITS station, assignment of VCIs to ITS-S applications is done automatically by the CI selection management specified in ISO 24102-1.

5.3.2 Reception

Reception notifications may be 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-SP numbers contained in the FNTP NPDU.

Valid notified packets addressed to an ITS-SP are given by a known destination port address. 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.

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

5.3.3 FNTP ITS-SPs

Allocation and deletion of dynamic and static well-known "ITS-S port" (ITS-SP) numbers is specified in 8.2.

NOTE Static well-known ITS-SP numbers are assigned to ITS applications by a registration authority, see [4].

5.4 Implementation architectures

FNTP may support the implementation architectures introduced in ISO 21217 and illustrated in Figures 2, 3 and 4 with the peer ITS stations A and B, indicating FNTP in the ITS-S networking and transport layer.

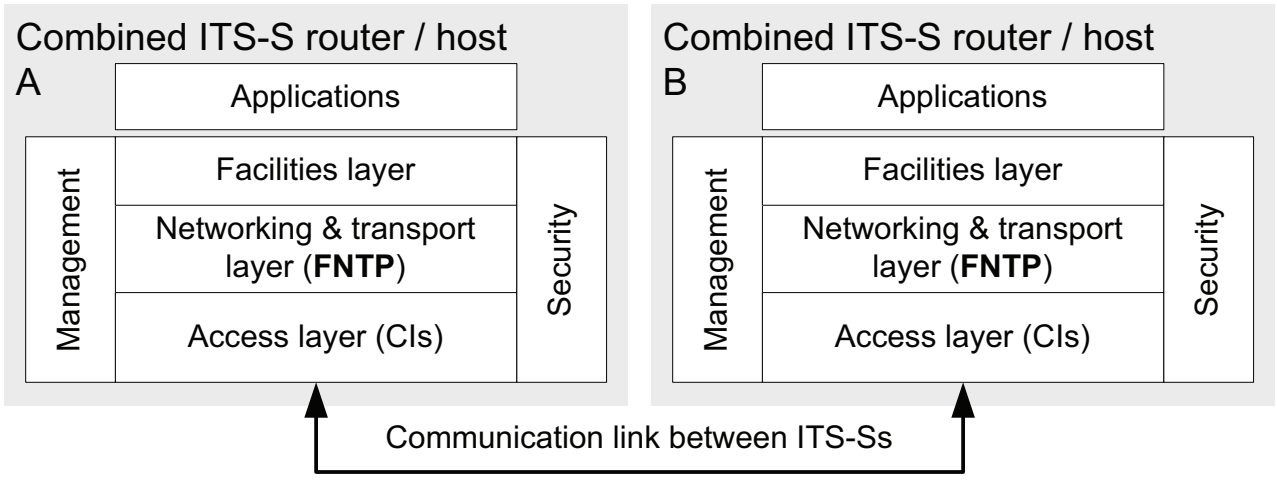

Figure 2 — Implementation architecture I

In case the FNTP is implemented in an ITS-SCU which does not have both roles of ITS-S host and ITS-S router, the ITS station-internal network shall be supported. This situation is illustrated in Figures 3 and 4.

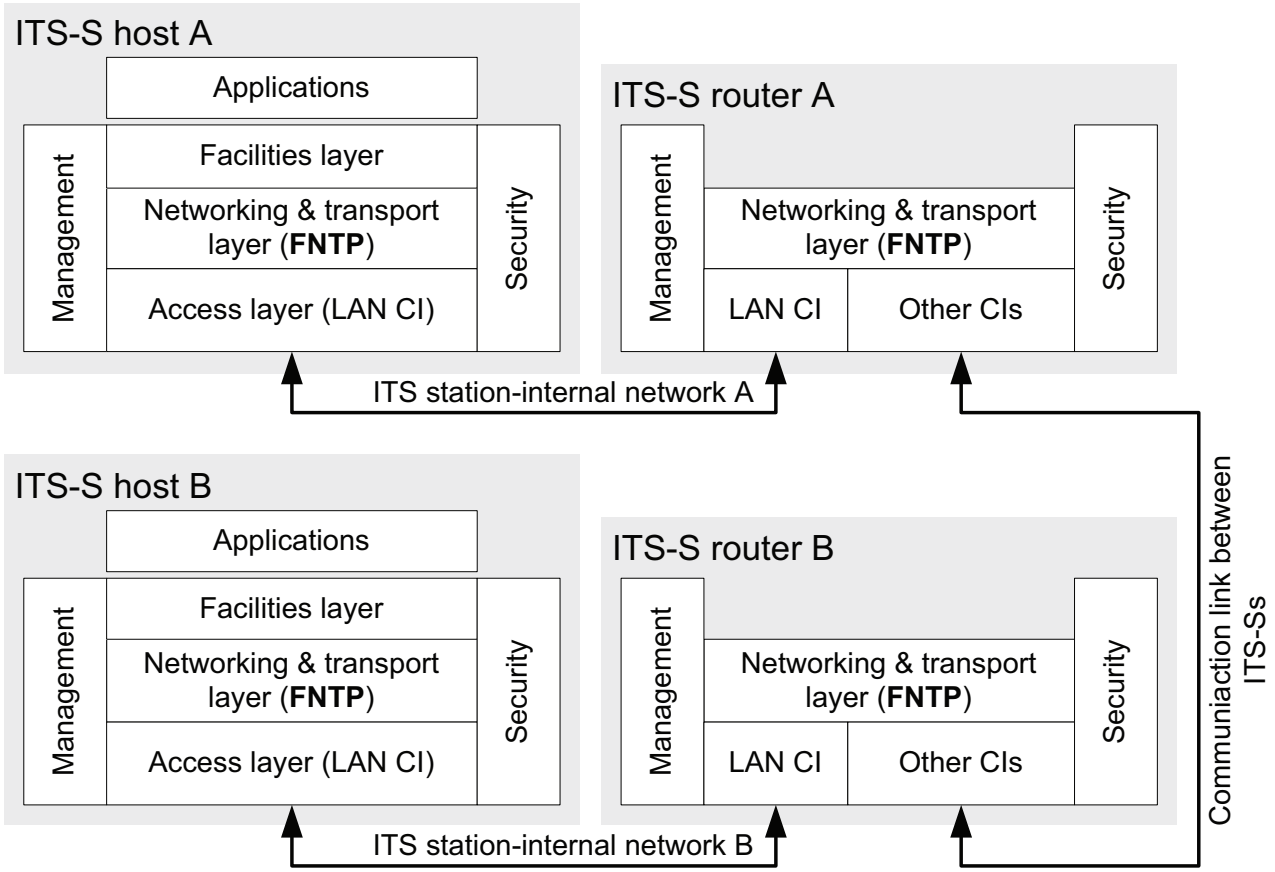

Figure 3 — Implementation architecture II

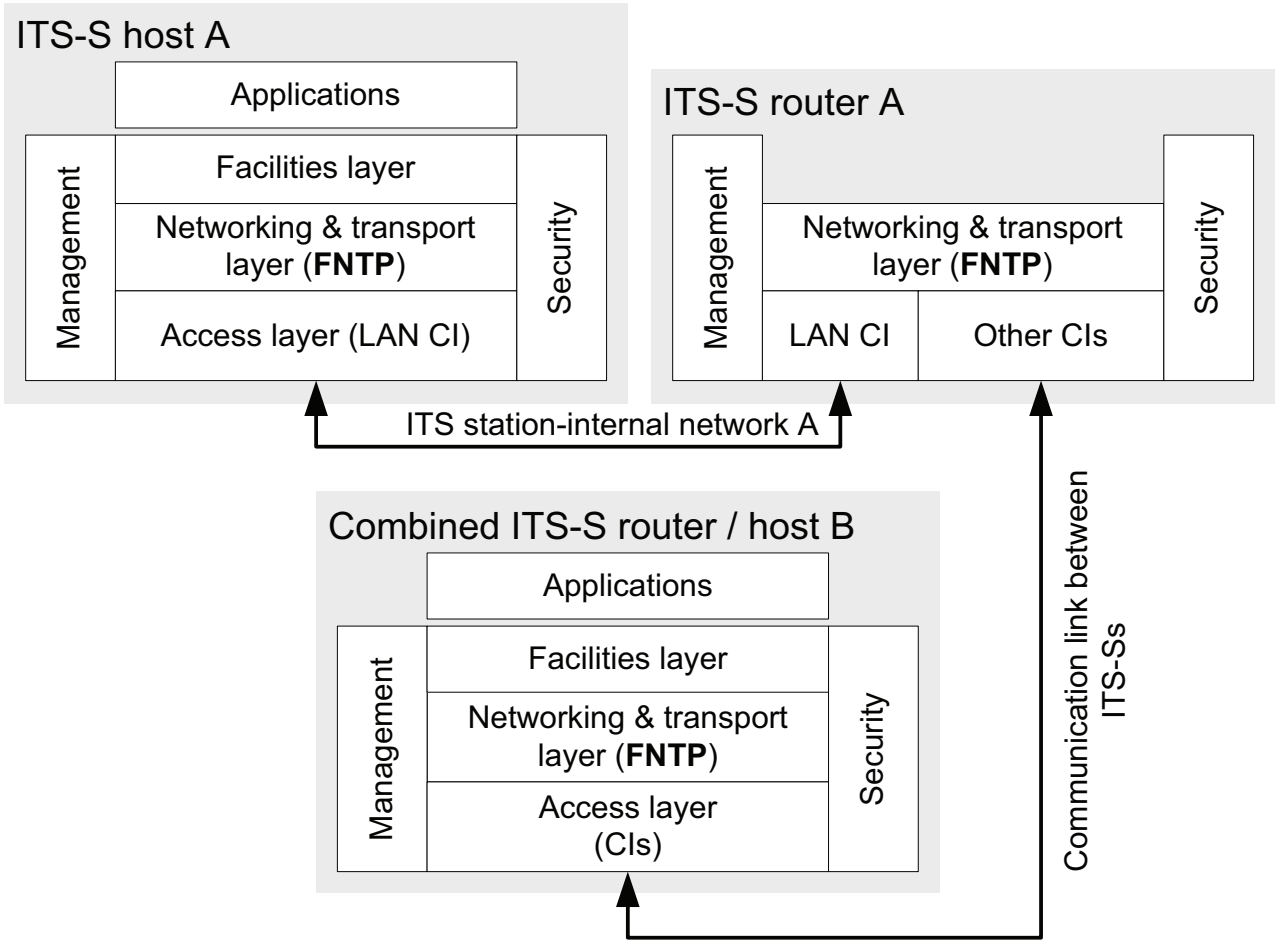

Figure 4 — Implementation architecture III

6 Protocol elements

6.1 Service access points

6.1.1 IN-SAP

The FNTP shall support IN-SAP functionality as specified in ISO 21218.

The FNTP is identified in the IN-SAP with the appropriate SAP address "fast communication without IPv6 addresses" as specified in ISO 21218. Only the even value of the two possible address values shall be applied for FNTP, as FNTP does not distinguish commands and responses.

NOTE An EtherType value for the FNTP [3] might be allocated to be used in MAC frames. However, this is outside the scope of this part of ISO 29281.

6.1.2 NF-SAP

The FNTP shall support NF-SAP functionality with details specified in this part of ISO 29281.

6.1.3 MN-SAP

The FNTP shall support MN-SAP functionality identified in this part of ISO 29281 and specified in ISO 24102-3.

6.1.4 SN-SAP

The FNTP may support functionality of the SN-SAP specified in ISO 24102-3 in order to enable secure communications.

6.2 FNTP NPDU

6.2.1 Structure

An FNTP NPDU shall consist of two fields as illustrated in Figure 5, i.e. the FNTP header and the FNTP body.

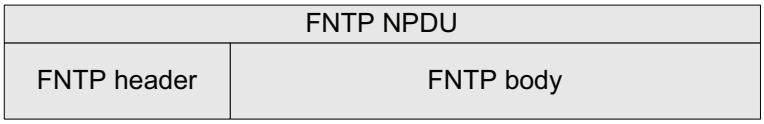

Figure 5 — Structure of an FNTP NPDU

ASN.1 details of the FNTP NPDU shall be as specified in Annex A.

6.2.2 FNTP header

6.2.2.1 Structure

The FNTP header illustrated in Figure 6 shall consists of two address fields for sourcePort and destinationPort, an FNTP control field, and Options fields as required by the value contained in the FNTP control field.

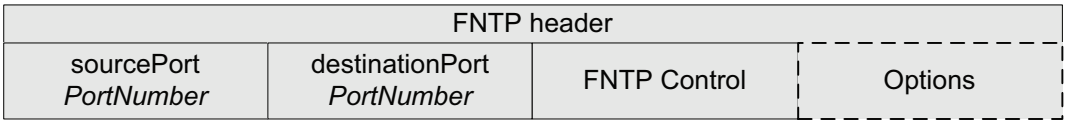

Figure 6 — Structure of an FNTP NPDU header

6.2.2.2 sourcePort and destinationPort

The FNTP header shall contain the numbers of source port and destination port of the given hop, respectively, as illustrated in Figure 6, i.e. indicating “end-points” as specified in Table 1.

Table 1 — ITS port numbers

Port number	Acronym	Description	Field size
0	PORT_SAM	Groupcast manager, i.e. the sourcePort and destinationPort of "Service Advertisement Messages" (SAM) and "Service Context Messages" (CTX) specified in ISO 24102-5(FSAP).	1 octet
1 - 127	PORT_DYN PORT_REG	Sub-division into a number range for static ports (PORT_REG) and for dynamic ports (PORT_DYN) preferably is done by a port number registration authority, or by future revisions of this document. Dynamic numbers are for general usage excluding "Legacy CI Port Manager" and "15628 Kernel Emulator" specified in [2].	
128 - 32716	PORT_DYN PORT_REG	Sub-division into a number range for static ports (PORT_REG) and for dynamic ports (PORT_DYN) preferably is done by a port number registration authority, or by future revisions of this document. Dynamic numbers are for general usage including "Legacy CI Port Manager" and "15628 Kernel Emulator" specified in [2].	2 octets
32717 - 32763	PORT_RES	Reserved for special purposes.	
32764	PORT_IIC	Port number for ITS station-internal management communications specified in ISO 24102-4.	
32765	PORT_RTR	FNTP management port in an ITS-S router, used in ITS station-internal forwarding mode of operation.	
32766	PORT_HST	FNTP management port in an ITS-S host, used in ITS station-internal forwarding mode of operation.	
32767	PORT_UNK	Unknown / don't care.	

NOTE Values of port numbers as shown above are examples. Assignment of numbers is expected to be done by a port number registration authority, see [4].

6.2.2.3 Selection of options

6.2.2.3.1 FNTP control field

Details of the "FNTP Control" and "Options" fields depends on the mode of operation:

— basic mode of operation;

— extended mode of operation.

The "FNTP Control" field value allows distinguishing details of these two modes of operation as specified in Table 2. The FNTP control field is a one octet bit-field as specified in Table 2.

The basic mode of operation is indicated by the value zero in the "FNTP Control" field. In this case, the FNTP NPDU is referred to as "FNTP basic NPDU" in this part of ISO 29281.

In the extended mode of operation, at least one "Option" field is present. Bit B7 indicates presence or absence of the first optional element following the FNTP control field; Bit B6 indicates presence or absence of the second optional element following the FNTP control field; and so on; Bit B0 indicates presence or absence of the last optional element following the FNTP control field. Presence of an optional element shall be indicated by a value '1'b in the respective bit field.

Reserved bits shall be set to the value **'0'**.

Table 2 — "FNTP Control" field (implemented as OPTION selector in ASN.1)

B7	B6	B5	B4	B3	B2	B1	B0	Description
'0'	'0'	'0'	'0'	'0'	'0'	'0'	'0'	Used in the NF-FNTP-COMM service to indicate, that no extension is to be applied.
'1'	no value	no value	no value	no value	no value	no value	no value	Option 0: ITS station-internal forwarding. The related Options field is present.
no value	'1'	no value	no value	no value	no value	no value	no value	Option 1: Support of secure communications. The related Options field is present.
no value	no value	'1'	no value	no value	no value	no value	no value	Option 2: N-hop broadcast. The related Options field is present.
no value	no value	no value	'1'	no value	no value	no value	no value	Option 3: So far undefined feature. The related Options field is of ASN.1 NULL type. Reserved for future.
no value	no value	no value	no value	'1'	no value	no value	no value	Option 4: So far undefined feature. The related Options field is of ASN.1 NULL type. Reserved for future.
no value	no value	no value	no value	no value	'1'	no value	no value	Option 5: So far undefined feature. The related Options field is of ASN.1 NULL type. Reserved for future.
no value	no value	no value	no value	no value	no value	'1'	no value	Option 6: LPP support. The related Options field is present.
no value	no value	no value	no value	no value	no value	no value	'1'	Option 7: CIP support. The related Options field is present.

An FNTP NPDU with "FNTP Control" field containing a value different to '00000000'b is referred to as "FNTP extended NPDU" in this International Standard.

6.2.2.3.2 ITS station-internal forwarding

In order to forward an FNTP NPDU station-internally between an ITS-S host and an ITS-S router or vice versa, the FNTP header shall contain values as specified in Table 3.

Table 3 — FNTP header values for station-internal forwarding

Forwarding direction	sourcePort field	destinationPort field
From FNTP management in ITS-S router to FNTP management in ITS-S host	PORT_RTR	PORT_HST
From FNTP management in ITS-S host to FNTP management in ITS-S router	PORT_HST	PORT_RTR

The FNTP Options field for station-internal forwarding shall be as illustrated in Figure 7.

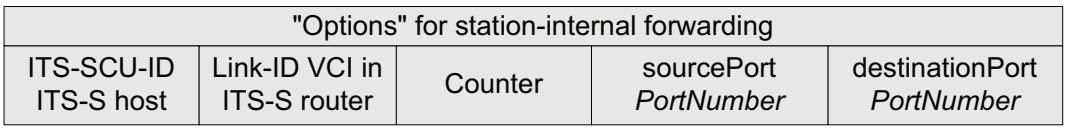

Figure 7 — FNTP header Options field for station-internal forwarding

ASN.1 details of the FNTP header Options field for station-internal forwarding illustrated in Figure 7 shall be as specified in Annex A.

The format of ITS-SCU-ID shall be as specified in ISO 24102-1. The format of Link-ID shall be as specified in ISO 21218.

The field “Counter” shall contain a cyclic packet counter being unique in the source ITS-SCU. The size of this field shall be one octet as specified in Annex A.

The fields sourcePort and destinationPort contain the port numbers used in the link between the peer ITS stations.

An FNTP NPDU for ITS station-internal forwarding is referred to as “FNTP forwarding NPDU” in this part of ISO 29281.

6.2.2.3.3 Secure communications

The FNTP Options field in support of secure communications shall be as illustrated in Figure 8.

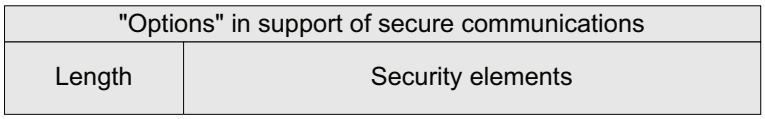

Figure 8 — FNTP header Options field in support of secure communications

Details of secure communications are not specified in this version of this part of ISO 29281.

ASN.1 details of the FNTP header Options field in support of secure communications illustrated in Figure 8 shall be as specified in Annex A.

6.2.2.3.4 N-hop broadcast

The FNTP Options field for N-hop broadcast shall be as illustrated in Figure 9.

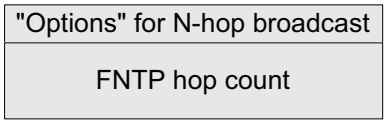

Figure 9 — FNTP header Options field for N-hop broadcast

ASN.1 details of the FNTP header Options field for N-hop broadcast illustrated in Figure 9 shall be as specified in Annex A.

The FNTP hop count indicates to the receiving ITS station the number of allowed subsequent hops.

6.2.2.3.5 LPP support

The related Options field shall contain the LPP header as specified in [1].

6.2.2.3.6 CIP management

The FNTP Options field for CIP management shall be as illustrated in Figure 10.

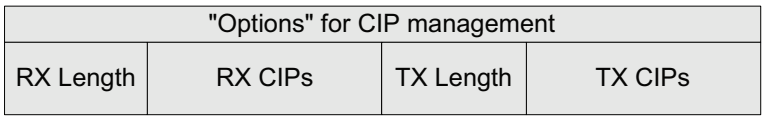

Figure 10 — FNTP header Options field for CIP management

The RX Length field indicates the length in octets of the RX CIPs field. The TX Length field indicates the length in octets of the TX CIPs field. At least either RX CIPs or TX CIPS shall be present. Details of CIPs

depend on the ITS-S access technology selected for communications and are outside the scope of this part of ISO 29281.

ASN.1 details of the FNTP header Options field for CIP management illustrated in Figure 10 shall be as specified in Annex A.

6.2.3 FNTP body

The FNTP body field shall contain an ITS-FPDU specified in ISO 21217 as illustrated in Figure 11.

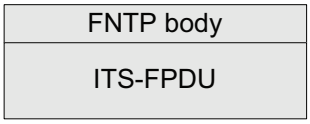

Figure 11 — FNTP body for basic mode of operation

6.3 Protocol management elements

6.3.1 Service look-up table

The FNTP shall maintain look-up information as illustrated in Figure 12.

ITS-S router	ITS-S host		
Link Port *PortNumber*	Service		
	Service Port *PortNumber*	ITS-SCU-ID	Service Priority

Figure 12 — Service look-up table

"Link Port" shall contain the port number used in the FNTP header in the link to a peer station or in the ITS station-internal network link, pointing indirectly to the ITS-SP of the service in the ITS-S host. "Service Port" shall contain the port number which points directly to the ITS-SP of the service in the ITS-S host.

NOTE 1 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" may have the same value, and the look-up information becomes obsolete.

"ITS-SCU-ID" shall identify the ITS-SCU of the ITS-S host where the service resides. "Service Priority" shall contain the maximum allowed user priority of the service.

NOTE 2 The term "service" used in this context means protocol functionality in the ITS-S facilities layer addressable by an ITS-SP number, which is using the communication service offered by an ITS-S networking and transport layer protocol, i.e. the FNTP.

This look-up information is part of the information contained in forwarding tables specified in 6.3.2.

6.3.2 Forwarding table

The FNTP shall maintain information as illustrated in Figure 13 needed to perform the protocol procedures specified in this part of ISO 29281.

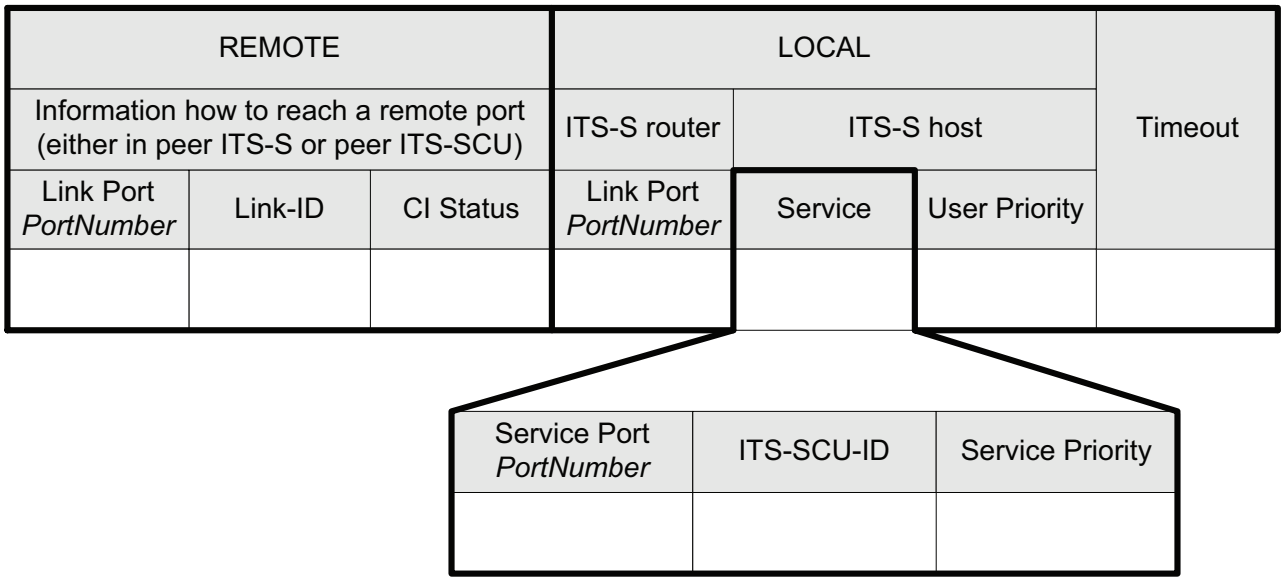

Figure 13 — Forwarding table

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

— The elements in column "Link Port" shall carry the port numbers as used in the communication link. A "Link Port" is unique only in combination with the corresponding "Link-ID".

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

— The element "CI Status" shall contain the CI status specified in ISO 21218.

NOTE 1 In case of ITS-S internal forwarding of FNTP NPDUs, Link Port is either PORT_HST or PORT_RTR, and Link-ID points to a BC-VCI which connects to the ITS station-internal network.

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

— The elements in column "Link Port" shall carry the port number as used in the link identifying the local ITS-SP 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 2 The two elements "Link Port" thus are the sourcePort and destinationPort port numbers used in the link between peer entities (ITS-Ss or ITS-SCUs), i.e. in the header shown in Figure 6.

— The element "Service" shall be as specified in 6.3.

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

NOTE 3 In case of ITS-S internal forwarding of FNTP NPDUs, Link Port is either PORT_HST or PORT_RTR, and Link-ID identifies the access technology which connects to the ITS station-internal network.

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

7 Protocol procedures

7.1 Service access points

7.1.1 General

As SAPs per definition describe a functional behaviour only, SAPs may be implemented in different ways. Requirements set up in this part of ISO 29281 to support SAPs and the related service primitives thus mean to support the functionality. This support may be implemented either in a strict meaning, i.e. using the ASN.1 definitions of the service primitives as "PDU" definitions, or in an abstract meaning, allowing for proprietary solutions.

7.1.2 IN-SAP

The FNTP shall interact with the ITS-S access layer specified in ISO 21217 using services of the IN-SAP specified in ISO 21218.

The FNTP shall support the IN-UNITDATA service of the IN-SAP specified in ISO 21218.

The FNTP may use the IN-UNITDATA-STATUS service of the IN-SAP. The IN-UNITDATA-STATUS service is specified in ISO 21218.

NOTE Usage of the information given by the IN-UNITDATA-STATUS service is not specified in this part of ISO 29281.

7.1.3 NF-SAP

The FNTP shall interact with the ITS-S facilities layer specified in ISO 21217 offering services of the NF-SAP specified in this part of ISO 29181.

The FNTP shall provide the NF-FNTP-PORT service and the NF-FNTP-COMM service of the NF-SAP specified in this part of ISO 29281.

7.1.4 MN-SAP

The FNTP shall interact with the ITS-S management entity specified in ISO 21217 using services of the MN-SAP specified in ISO 24102-3.

7.1.5 SN-SAP

The FNTP may interact with the ITS-S management entity specified in ISO 21217 using services of the SN-SAP specified in ISO 24102-3.

7.2 Port management

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

— uniquely assigning dynamic port numbers to local ports;

— mapping local ports to remote ports.

NOTE The port management may serve several ITS networking and transport layer protocols, not just FNTP.

7.3 Maintenance of entries in forwarding tables

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

Such 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-S).

Remote maintenance of FNTP forwarding tables may be performed with ITS station-internal management communications specified in ISO 24102-4, if applicable.

Creation of an entry in a forwarding Table shall be notified to the ITS-S management using the service primitive MN-REQUEST(FWTsetNot(SetNotFNTP)) specified in Annex A and in ISO 24102-3.

Update of an entry in a forwarding Table shall be notified to the ITS-S management using the service primitive MN-REQUEST(FWTsetNot(UpdateNotFNTP)) specified in Annex A and in ISO 24102-3.

Deletion of an entry in a forwarding Table shall be notified to the ITS-S management using the service primitive MN-REQUEST(FWTsetNot(DeleteNotFNTP)) of the MN-SAP specified in Annex A and in ISO 24102-3.

7.4 Initial settings of forwarding tables in ITS-S hosts

7.4.1 Allocation and deletion of a port

Upon allocation of a port by means of the NF-FNTP-PORT service, entries in the forwarding tables of the FNTP as presented in Figure 14 shall be 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 service)	of service	never (0)

Figure 14 — 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 shall be deleted.

7.4.2 Assignment of communication interfaces

In case ITS station internal forwarding is needed, the entry in the forwarding table presented in Figure 15 is needed. The setting shall be done by the ITS-S management using the service primitive MN-COMMAND(FWTset(SetFNTP)) specified in Annex A 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_RTR	BC-VCI	active	PORT_HST	(of service)	of service	never (0)

Figure 15 — Forwarding table host — Activation of a VCI for ITS station-internal network

In Figure 15, different to the case of communication between ITS stations, for ITS station-internal forwarding, the entry below:

— "REMOTE" indicates how the ITS-S host ITS-SCU can access an ITS-S router ITS-SCU;

— "ITS-S router Link Port" is used in the ITS station-internal network to identify an ITS-S host ITS-SCU.

The CI selection management may change the assignment of a CI as specified in ISO 24102-1.

Upon deregistration of the port by means of the NF-FNTP-PORT service, all related entries shall be deleted.

7.5 Initial settings of forwarding tables in ITS-S routers

7.5.1 Assignment of communication interfaces

In case ITS station internal forwarding is needed, the entry in the forwarding table presented in Figure 16 is needed. The setting shall be done by the ITS-S management using the service primitive MN-COMMAND(FWTset(SetFNTP)) specified in Annex A 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_HST	BC-VCI	active	PORT_RTR	(of service)	of service	never (0)

Figure 16 — Forwarding Table router

In Figure 16, different to the case of communication between ITS stations, for ITS station-internal forwarding, the entry below:

— "REMOTE" indicates how the ITS-S router ITS-SCU can access an ITS-S host ITS-SCU;

— "ITS-S router Link Port" is used in the ITS station-internal network to identify an ITS-S router ITS-SCU.

The CI selection management may change the assignment of a CI as specified in ISO 24102-1.

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

7.6 Transmitting packets

7.6.1 NF-SAP transmission request

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

If no such entry exists, the transmission request shall be discarded and 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:

— REMOTE ITS-S entries:

  — Valid Link Port, see Table 1,

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

- LOCAL ITS-S entries:
  - Valid Link Port, see Table 1, identifying the local ITS-SP for potential replies by the peer station.
  - Valid Service Port, see Table 1, and valid ITS-SCU-ID identifying together uniquely an ITS-SP in the local ITS station.

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

Without the need to discard the transmission request, 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 FNTP shall perform the "Forwarding host to router procedure", which is an option of the "Extended procedure".

Without the need of ITS station-internal forwarding, the FNTP shall check "controlField" specified in Table 2 given in the service primitive.

- If "controlField" is equal to '00000000'b, the "Basic procedure" shall be performed.
- Otherwise, the "Extended procedure" shall be performed.

7.6.2 Basic procedure

The FNTP shall

- create an "FNTP NPDU" illustrated in Figure 5 for basic mode of operation as specified in 5.1.2 with an
  - FNTP header illustrated in Figure 6 indicating "destinationPort" equal to "remotePort" and "sourcePort" equal to "servicePort" as given in the service primitive, "FNTP control field" set equal to '00000000'b,
  - FNTP body illustrated in Figure 11 with "ITS-FPDU" equal to "data" given in the service primitive.
- forward the "FNTP NPDU" to the proper VCI by means of the IN-UNITDATA.request service primitive specified in ISO 21218, if no other service primitive is requested, 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.

The FNTP shall

- notify failure of transmission by means of the service primitive NF-FNTP-COMM.confirm.

7.6.3 Extended procedure

The FNTP shall check "controlField" given in the service primitive

- if "controlField" contains a value for an option which is not supported, or an invalid combination of options, the transmission request shall be discarded, and the FNTP shall notify failure of transmission by means of the service primitive NF-FNTP-COMM.confirm.
- otherwise the procedure as specified below shall be performed.

The FNTP shall

— create an “FNTP NPDU” illustrated in Figure 5 for extended mode of operation as specified in 5.1.3 with an

  — FNTP header illustrated in Figure 6 indicating “destinationPort” and “sourcePort” of to the next hop, “FNTP control field” as requested by “controlField” or by FNTP security, “Options” as given by “FNTP control field”,

  — FNTP body illustrated in Figure 11 with “ITS-FPDU” equal to “data” given in the service primitive,

— perform CIP management as specified in 7.9, if applicable.

— forward the “FNTP NPDU” to the proper VCI by means of the IN-UNITDATA.request service primitive specified in ISO 21218, if no other service primitive is requested, 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.

The FNTP shall

— notify failure of transmission by means of the service primitive NF-FNTP-COMM.confirm.

7.6.4 Forwarding host to router procedure

The “Forwarding host to router procedure” is a special option of the “Extended procedure”.

The FNTP shall create an “FNTP NPDU” illustrated in Figure 5 for extended mode of operation with an

— FNTP header illustrated in Figure 6 indicating forwarding from ITS-S host to ITS-S router specified in Table 3, with the forwarding “Options” field illustrated in Figure 7, “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, “destinationPort” equal to “remotePort” and “sourcePort” equal to “servicePort”;

— FNTP header containing other options as requested;

— FNTP body illustrated in Figure 11 with “ITS-FPDU” equal to “data” given in the service primitive.

The FNTP shall

— forward the “FNTP NPDU” to the proper VCI by means of the IN-UNITDATA.request service primitive specified in ISO 21218, if no other service primitive is requested, 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 cyclic packet counter shall be incremented by one for every new 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” shall 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 part of ISO 29281.

7.7 Receiving packets

7.7.1 Checking of FNTP header

Upon reception of a data packet via the IN-SAP specified in ISO 21218, the FNTP shall first check the FNTP header.

1) If the FNTP header contains the value PORT_UNK, the NPDU shall be discarded, as at least one of the ITS-SPs is illegal.

2) If one of the two port numbers in the FNTP header equals PORT_RTR, and the other port number is different to PORT_HST, the NPDU shall be discarded due to illegal addresses.

3) If one of the two port numbers in the FNTP header equals PORT_HST, and the other port number is different to PORT_RTR, the NPDU shall be discarded due to illegal addresses.

4) If the packet is received at an ITS-S router, and the FNTP header indicates an ITS-SP in an ITS-S host contained in another ITS-SCU, FNTP shall perform the "Forwarding router to host procedure".

5) If the "FNTP Control" field indicates ITS station-internal forwarding with "sourceAdress" field in the FNTP header containing the number PORT_RTR, and the "destinationAdress" field in the FNTP header containing the number PORT_HST, the FNTP shall perform the "forwarded delivery procedure".

6) If the "FNTP Control" field indicates ITS station-internal forwarding with "sourceAdress" field in the FNTP header containing the number PORT_HST, and the "destinationAdress" field in the FNTP header containing the number PORT_RTR, the FNTP shall perform the "send procedure".

7) If the field "FNTP Control" field in the FNTP header contains a value different to '00000000'b, FNTP shall perform the "extended delivery procedure".

8) In all other cases FNTP shall perform the "basic delivery procedure".

7.7.2 ITS-SP check and forwarding Table update

The FNTP shall check destinationPort contained in the NPDU.

— If the destinationPort does not match any LOCAL Link Port associated with a "Service Port" entry in the service look-up table, the packet shall be discarded, as the final ITS-SP is not known.

In case the packet is not discarded due to an unknown final ITS-SP, 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, an entry shall be created as presented in Figure 17.

— If "Link-ID" contained in destination_address indicates a so-far unknown BC-VCI, an entry shall be created in the forwarding table as presented in Figure 17 in order to enable N-Hop broadcast forwarding.

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 ITS_S access layer	never (0)

Figure 17 — Forwarding table — New entry upon reception of packet

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	Link-ID contained in destination_ address	connected	PORT_UNK	unknown	0	never (0)

Figure 18 — Forwarding table — New entry upon reception of packet in broadcast mode

For every match in the forwarding table, the packet shall be further processed accordingly.

7.7.3 Basic delivery procedure

The FNTP shall perform the ITS-SP check and update of the forwarding table.

The FNTP shall notify reception of the NPDU by means of the NF-FNTP-COMM.indication service primitive with “servicePort” set to “destinationPort”, “remotePort” set to “sourcePort”, “linkID” set to Link-ID contained in “source_address”, “data” set to “ITS-FPDU”, “priority” set to the value received in the service primitive from the IN-SAP.

7.7.4 Extended delivery procedure

The FNTP shall check “FNTP Control” field illustrated in Figure 6.

— If secure communications is selected, the appropriate security mechanism shall be applied in addition to the ordinary processing. If secure communications is not supported, the whole NPDU shall be discarded.

— If N-hop broadcast is selected, the N-hop broadcast procedure shall be performed.

— If LPP support is selected, the LPP procedure shall be performed.

— If CIP management is selected, the appropriate procedure as specified in this part of ISO 29281 shall be applied in addition to the ordinary processing.

— If a bit for an unknown or non-supported option is set, this option shall be ignored, except it is the option for secure communications.

— If only one or several unknown options are indicated, the NPDU shall be discarded.

NOTE 1 Description of details of the LPP procedure is outside the scope of this part of ISO 29281.

NOTE 2 Details of security mechanisms are outside the scope of this version of this part of ISO 29281.

7.7.5 N-hop broadcast procedure

The FNTP shall first check “FNTP hop count” illustrated in Figure 9.

— If the “FNTP hop count” is larger than zero, the FNTP NPDU shall be retransmitted in broadcast mode with “FNTP hop count” decremented by one.

The FNTP shall perform the basic delivery procedure.

7.7.6 Forwarded delivery procedure

The FNTP shall check "ITS-SCU-ID ITS-S host" illustrated in Figure 7.

— If "ITS-SCU-ID ITS-S host" indicates the ITS-SCU-ID of another host, the packet shall be discarded.

Without the need to discard the packet, the FNTP shall check, whether the "Basic delivery procedure" or the "Extended delivery procedure" applies, and shall perform the required delivery procedure, considering optional CIP management specified in 7.9, and optional security procedures.

7.7.7 Send procedure

The FNTP shall

— create and "FNTP NPDU" for transmission to a remote ITS-S;

— forward the "FNTP NPDU" to the proper VCI identified by "Link-ID of VCI in ITS-S router" with the IN-UNITDATA.request service primitive specified in ISO 21218, if no other service primitive is requested, 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.

7.7.8 Forwarding router to host procedure

The FNTP shall perform the following steps:

— Create an "FNTP forwarding NPDU" for station-internal forwarding mode of operation with an ITS station-internal forwarding "Options" field illustrated in Figure 7, with an FNTP header indicating forwarding from ITS-S router to ITS-S host specified in Table 3, with the content of parameter "data" received in the IN-UNITDATA.indication service primitive used as "FNTP NPDU", "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 CI in the ITS-S router used for reception of the packet, and the cyclic packet counter in "Flags" set to the next valid value. Optional CIP management shall be as specified in 7.9.

— Forward this FNTP forwarding NPDU to the proper VCI connecting to the ITS station-internal network by means of the IN-UNITDATA.request service primitive specified in ISO 21218, if no other service primitive is requested, 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 cyclic packet counter shall be incremented by one for every new station-internal forwarding. It shall wrap from 255 to zero. The counter value, together with the addresses "ITS-SCU-ID host" and "LINK-ID VCI" shall 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 part of ISO 29281.

7.8 Management of forwarding tables

7.8.1 Settings of forwarding tables

The FNTP shall accept requests from the ITS station management entity specified in ISO 24102-3 to set, update, and delete entries in FNTP forwarding tables by means of the service primitive MN-COMMAND.request, using MN-Commands "FWTset", "FWTupdate" and "FWTdelete" specified in Annex A.

7.8.2 Notification of changes in forwarding tables

All changes in the forwarding tables performed by the FNTP shall be notified to the ITS station management entity specified in ISO 24102-3 by means of the service primitive MN-REQUEST.request, using MN-Requests "FWTsetNot", "FWTupdateNot" and "FWTdeleteNot" specified in Annex A.

7.9 CIP management

7.9.1 Purpose of CIPs

"Communication Interface Parameters" (CIPs) may be used to request setting of transmit (TX) parameters of a VCI used to connect to a peer ITS station prior to transmission of a packet, when those parameters need to be changed on a packet-by-packet basis. TX CIPs shall be reported to the selected VCI in parameter "access_parameters" of the IN-UNITDATA.request service primitive specified in ISO 21218.

In receive mode notification of RX CIPs related to receive (RX) parameter settings of the own receiving CI shall be in parameter "access_parameters" of the IN-UNITDATA.indication service primitive specified in ISO 21218.

CIPs related to TX parameters of the peer ITS station being may be contained in an "FNTP extended NPDU" for extended mode of operation.

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

If TX CIPs shall be forwarded to a peer ITS station as a CIP header in the "FNTP extended NPDU", the FNTP shall create a CIP header, and shall put the CIPs into parameter "access_parameters" prior to sending the transmission request to the selected VCI.

If forwarding of TX CIPs to a peer ITS station shall not be performed, then the FNTP of the ITS-S router shall ensure, that CIPs are only present in parameter "access_parameters", but not contained in a CIP header of the NPDU.

However if setting of CIPs or evaluation of 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 extended NPDU shall be removed after the first hop in case of N-hop broadcast.

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

The FNTP at the ITS-S host shall create an "FNTP forwarding NPDU" as specified in 7.6.4 with a CIP header of ASN.1 type CIPheader specified in Annex A. The FNTP shall:

— notify failure of transmission by means of the service primitive NF-FNTP-COMM.confirm.

The receiving ITS-S router in the same ITS station shall inspect the CIP header. In case, forwarding of the CIP header to the peer ITS station shall be prohibited, the CIP header shall be removed from the NPDU. Then the remaining NPDU shall be processed as specified in 7.7.7., with parameter "access_parameters" set equal to the content of the CIP header.

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

Upon reception of an NPDU from a CI, the FNTP shall inspect parameter "access_parameters" of the IN-UNITDATA.indication service primitive, and shall make these parameters available to the proper destination in the ITS-S router. Definition of such a destination is outside the scope of this part of ISO 29281. If such a destination is not known in an implementation, all CIP information shall be discarded.

In case RX CIP parameters of the own CI are present, the FNTP shall add these RX parameters to the existing CIP header which contains TX CIP parameters from the peer ITS station, if applicable, or shall create a CIP header which contains these RX CIPs. The CIP header shall properly indicate which types of CIPs are present. Then the "Forwarding router to host procedure" specified in 7.7.8 shall be performed.

At the ITS-S host, the FNTP shall remove the CIP header from the NPDU, and shall make these CIPs available to the ITS-SP of the packet using the NF-FNTP-COMM.indication service primitive.

Usage of this CIP information in the ITS-S facilities layer is outside the scope of this part of ISO 29281.

8 NF-SAP services

8.1 Overview

The FNTP shall provide the functionality of the service 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-SP.

NF-FNTP-PORT.confirm provides a port number allowing the ITS-SP to use the NF-FNTP-COMM service, and shall be 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-SP 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-SP.

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

8.2 NF-FNTP-PORT

8.2.1 NF-FNTP-PORT.request

The service primitive

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

is used by the ITS-S facilities layer to request allocation or deletion of a port number associated with an ITS-SP.

Parameter “serviceRef” shall be a number uniquely identifying the ITS-SP at this host in an implementation specific way.

Parameter “operation” shall indicate creation or deletion of a port.

Parameter “port” shall contain 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” shall be the user priority of the ITS application object 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 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 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-SP, "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;

— optionally notify other ITS-SCUs in the same instance of an ITS station about the new entry.

In order to delete a port number, the FNTP shall

— delete the related entries in the service look-up table;

— delete related entries in the forwarding table;

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

— optionally notify other ITS-SCUs in the same instance of an ITS station about deletion of the port number.

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

8.2.2 NF-FNTP-PORT.confirm

The service primitive

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

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" shall contain the Service port number assigned by the FNTP.

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_UNK to parameter "port".

8.3 NF-FNTP-COMM

8.3.1 NF-FNTP-COMM.request

The service primitive

```
NF-FNTP-COMM.request          (
     commRef,
     servicePort,
     remotePort,
     linkID,
     data,
     priority,
     controlField,
     hopCount (optional, defined by controlField),
     lppCtrl (optional, defined by controlField)
```

```
        cip (optional, defined by controlField)
        )
```

Parameter “commRef” shall contain the value of a cyclic counter identifying this request. A value shall be assigned under the responsibility of the ITS-SP.

Parameter “servicePort” shall identify the local service port number to be used for transmission of the packet, as assigned at time of creation of the related association between the port number and the ITS-SP.

Parameter “remotePort” shall indicate the destination port number, i.e. the peer ITS-SP.

Parameter “linkID” 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-SP is achieved.

NOTE 1 Selection of communication interfaces (CI) for ITS-S application objects generally shall be done by the CI selection management specified in ISO 24102-1. 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 “linkID”, “CIID” is set to “any”, “ITS-SCU-ID” is set to “any router”, and “SerialNumber” shall indicate either “broadcast” or “multicast”, as applicable.

Parameter “data” shall contain the ITS-SP payload ITS-FPDU.

Parameter “priority” shall contain the priority value for this transmission request.

Parameter “controlField” shall contain the content of the “FNTP control field” illustrated in Figure 6.

Parameter “hopCount” shall indicate the initial value to be put into the element “FNTP hop count” illustrated in Figure 9. For single-hop communications, this parameter shall be set to zero.

Parameter “lppCtrl” shall contain information needed for the FNTP option LPP.

Parameter “cip” shall contain CIP parameters to be contained in the NPDU, and to be used in the IN-SAP parameter access_parameters.

NOTE 3 How CIP can be used in access_parameters without being contained in the NPDU is not specified in this part of ISO 29281.

This service primitive shall be generated upon transmission request from the ITS-SP which requested allocation of the port number.

Upon reception of this service primitive, the FNTP shall create the NPDU and shall request transmission of the NPDU via the selected VCI with user priority as given in the forwarding table.

In case local forwarding to an ITS-S router is needed, an FNTP NPDU for station-internal forwarding mode of operation shall be created.

8.3.2 NF-FNTP-COMM.confirm

The service primitive

```
NF-FNTP-COMM.confirm          (
      commRef,
      servicePort,
      errStatus
      )
```

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” and “servicePort” 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 4.

Table 4 — 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 part of ISO 29281.

8.3.3 NF-FNTP-COMM.indication

The service primitive

```
NF-FNTP-COMM.indication         (
     servicePort,
     remotePort,
     linkID,
     data,
     priority,
     controlField,
     hopCount (optional, defined by controlField),
     lppCtrl (optional, defined by controlField),
     cip (optional, defined by controlField)
     )
```

is used by the FNTP to indicate to the ITS-S facilities layer reception of a packet for the ITS-SP which created the selected service port.

Parameter “servicePort” shall be set equal to “destinationPort” given in the NPDU.

Parameter “remotePort” shall be set equal to “sourcePort” given in the NPDU.

Parameter “linkID” shall identify the VCI associated with the peer station.

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

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

Parameter “controlField” shall contain the content of the “FNTP control field” illustrated in Figure 6.

Parameters “hopCount”,”lppCtrl” and “cip” shall provide the values as contained in the respective optional fields contained in the received NPDU, as applicable.

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

9 Conformance

The “Protocol Implementation Conformance Statements” (PICS) proforma is specified in ETSI TS 102 985-1.

10 Test methods

The “Test Suite Structure & Test Purposes (TSS&TP) for conformance testing are specified in ETSI TS 102 985-2.

The “Abstract Test Suite” (ATS) for conformance testing is specified in ETSI TS 102 985-3.

Annex A
(normative)

ASN.1 modules

A.1 Overview

The following ASN.1 module is specified in this Annex:

— **CALMfntp** { ISO (1) standard (0) calm-nonip (29281) fntp (2) version1 (1)}

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

A.2 Module CALMfntp

This module specifies ASN.1 type definitions together with useful ASN.1 value definitions.

It imports ASN.1 definitions from modules specified in ISO 21218, ISO 24102-1, ISO 24102-5, [2].

Unaligned packed encoding rules (PER) as specified in ISO/IEC 8825-2 shall be applied for this ASN.1 module.

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

```
CALMfntp { iso (1) standard (0) calm-nonip(29281) fntp(1) version1 (1)}

DEFINITIONS AUTOMATIC TAGS::=BEGIN

IMPORTS

CIstatus, Link-ID, UserPriority FROM CALMllsap {iso(1) standard(0) calm-ll-sap(21218) ver-
sion1(1)}

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

NTtimeout FROM CALMfsap { iso (1) standard (0) calm-management (24102) fsap (5) version1
(1)}

FNTPlpp FROM CALMlegacySupport { iso (1) standard (0) calm-nonip(29281) legacy (2) ver-
sion1 (1)}

;

-- End of IMPORTS

-- Types

-- PDUs --

    -- FNTP NPDU --

FNTPNPDU::=SEQUENCE{
    header    FTNPHeader,
    body      ITSfpdu -- specific to an ITS-S application / message
    }

FNTPHeader::=SEQUENCE{
    sourcePort      PortNumber,
    destinationPort PortNumber,
```

```
    options   FntpOptions
    }

FntpOptions::=SEQUENCE{
    intForw   FNTPintForwarding OPTIONAL,
    sec       FNTPsecurity OPTIONAL,
    hops      FNTPhopCount OPTIONAL,
    opt4      NULL OPTIONAL,
    opt5      NULL OPTIONAL,
    opt6      NULL OPTIONAL,
    lpp       FNTPlpp OPTIONAL,
    cip       FNTPCIPheader OPTIONAL
    }

FNTPintForwarding::=SEQUENCE{
    hostITS-scuId   ITS-scuId,
    link      Link-ID,
    counter   FNTPpacketCounter,
    sourcePort      PortNumber,
    destinationPort PortNumber
    }

FNTPpacketCounter::=INTEGER(0..255)

FNTPsecurity::=OCTET STRING (SIZE(0..65535))

FNTPhopCount::=INTEGER(0..255)

FNTPCIPheader::=SEQUENCE{
    rxCIP     RXcip,
    txCIP     TXcip
    }

RXcip::=OCTET STRING (SIZE(0..255))

TXcip::=OCTET STRING (SIZE(0..255)) - may optionally be forwarded to peer ITS station

- Managements SAP service primitives -
- Payload definitions for primitives defined in ISO 24102:-

   - MN-SAP -

      - FWTxxx -

DeleteFNTP::=SEQUENCE{
    reference INTEGER(0..noFNTPfwtEntries)
    }

DeleteNotFNTP::=SEQUENCE{
    reference INTEGER(0..noFNTPfwtEntries)
    }

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

SetConfFNTP::=SEQUENCE{
    reference INTEGER(0..noFNTPfwtEntries)
    }

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

```
SetNotFNTP::=SEQUENCE{
    reference INTEGER(0..noFNTPfwtEntries),
    remotePort      PortNumber,
    linkID    Link-ID,
    ciStatus  CIstatus,
    linkPort  PortNumber,
    serviceInfo     HostServiceInfo,
    priority  UserPriority,
    timeout   NTtimeout
    }

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

UpdateNotFNTP::=SEQUENCE{
    fill      BIT STRING (SIZE(1)),
    reference INTEGER(0..noFNTPfwtEntries),
    remotePort      PortNumber OPTIONAL,
    linkID    Link-ID OPTIONAL,
    ciStatus  CIstatus OPTIONAL,
    linkPort  PortNumber OPTIONAL,
    serviceInfo     HostServiceInfo OPTIONAL,
    priority  UserPriority OPTIONAL,
    timeout   NTtimeout OPTIONAL
    }

- NF-SAP -

NFsapPrimitivesDown::=SEQUENCE{
    fill      BIT STRING (SIZE(7)),
    primitivesDown  CHOICE{
        fntpPortRequest    NFfntpPortRequest,
        fntpCommRequest    NFfntpCommRequest
        }
    }

NFsapPrimitivesUp::=SEQUENCE{
    fill      BIT STRING (SIZE(6)),
    primitivesUp    CHOICE{
        fntpPortConfirm     NFfntpPortConfirm,
        fntpCommConfirm     NFfntpCommConfirm,
        fntpCommIndication NFfntpCommIndication
}
    }

NFfntpPortRequest::=SEQUENCE{
    serviceRef      INTEGER,
    operation BOOLEAN,
    port      PortNumber,
    priority  UserPriority
    }

NFfntpPortConfirm::=SEQUENCE{
    serviceRef      INTEGER,
    servicePort     PortNumber
    }

NFfntpCommRequest::=SEQUENCE{
    commRef   INTEGER(0..255),
    servicePort     PortNumber,
    remotePort      PortNumber,
```

```
    linkID    Link-ID,
    data      ITSfpdu,
    priority  UserPriority,
    controlField    FntpOptions - some options do not apply
    }

NFfntpCommConfirm::=SEQUENCE{
    commRef   INTEGER(0..255),
    servicePort     PortNumber,
    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,
    data      ITSfpdu,
    priority  UserPriority,
    controlField    FntpOptions
    }
```

- General types -

```
PortNumber::=CHOICE{
    portShort INTEGER(0..127),
    portLong  INTEGER(0..32767)
    }
```

- ITSfpdu as defined by application. Details not known to FNTP

- 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
```

Bibliography

[1] ARIB STD-T88:2004, *DSRC application sub-layer*

[*2*] ISO 29281-2, *Intelligent transport systems — Communication access for land mobiles (CALM) — Non-IP networking — Part 2: Legacy system support*

[3] IEEE EtherType Registry. http://standards.ieee.org/develop/regauth/ethertype/eth.txt

[4] ISO 17419, *Intelligent transport systems — Co-operative systems — Classification and management of ITS applications in a global context*

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