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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.

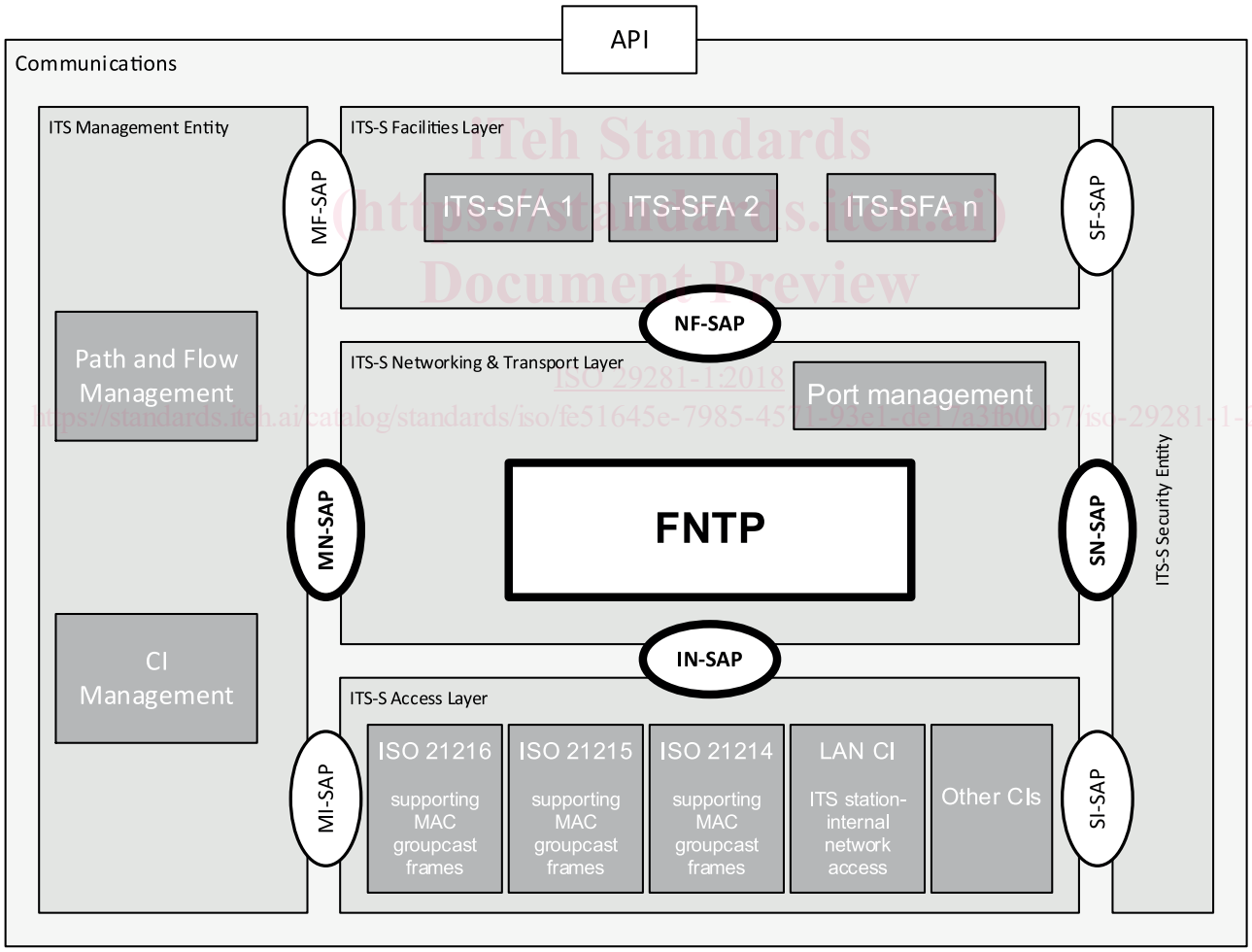

Figure 1 — FNTP reference architecture

"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.