Final draft ETSI EN 302 636-5-1 V1.2.1 (2014-05)

Intelligent Transport Systems (ITS);
Vehicular Communications;
GeoNetworking;
Part 5: Transport Protocols;
Sub-part 1: Basic Transport Protocol

Reference
REN/ITS-0030036

Keywords
addressing, autonomic networking, ITS, network, protocol

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Sous-Préfecture de Grasse (06) N° 7803/88

Contents

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Foreword

This final draft European Standard (EN) has been produced by ETSI Technical Committee Intelligent Transport Systems (ITS), and is now submitted for the Vote phase of the ETSI standards EN Approval Procedure.

The present document is part 5, sub-part 1 of a multi-part deliverable. Full details of the entire series can be found in ETSI EN 302 636-1 [2].

Proposed national transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	18 months after doa

Introduction

The Basic Transport Protocol (BTP) provides an end-to-end, connection-less transport service in the ITS ad hoc network. Its main purpose is the multiplexing of messages from different processes at the ITS facilities layer, e.g. CAM and DENM from the cooperative awareness basic service and the distributed environmental notification basic service, for the transmission of packets via the GeoNetworking protocol as well as the de-multiplexing at the destination. BTP enables protocol entities at the ITS facilities layer to access services of the GeoNetworking protocol and to pass protocol control information between the ITS facilities layer and the GeoNetworking protocol.

Message multiplexing/demultiplexing is based on ports, an ITS station-internal 16 bit address. A port represents a communication endpoint that identifies the ITS station protocol entity at the source (source port) or the destination (destination port). The usage of ports is similar to the two-stage packet transport in the IP protocol suite, where the IP provides the routing of packets from source to destination and the transport protocol, such as UDP, multiplexes/demultiplexes messages from/to application processes. In the case of BTP, the GeoNetworking protocol transports the packets among the ITS stations and the BTP protocol delivers the packets to the entities at the ITS facilities layer. BTP also adopts the concept of "well-known ports" from the IP protocol suite that assigns fixed ports to specific ITS facilities layer protocols. The definition of the ports, however, is beyond the scope of the present document.

BTP is a lightweight protocol: It has a 4-byte protocol header and requires minimal processing. It provides an unreliable transport of packets, i.e. packets can arrive out-of-order, appear duplicated or can be lost. The design of BTP assumes that entities using the protocol are either tolerant against the unreliable packet transport or provide appropriate mechanisms for reliable communication in their protocols.

1 Scope

The present document specifies the Basic Transport Protocol (BTP) for the transport of packets among ITS stations. It resides on top of the GeoNetworking protocol specified in ETSI EN 302 636-4-1 [5] and ETSI TS 102 636-4-2 [i.2] and below the ITS-S facilities layer. It provides an end-to-end, connection-less and unreliable transport service.

2 References

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

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

2.1 Normative references

The following referenced documents are necessary for the application of the present document.

[1] ETSI EN 302 665: "Intelligent Transport Systems (ITS); Communications Architecture".

[2] ETSI EN 302 636-1: "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 1: Requirements".

[3] ETSI EN 302 636-2: "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 2: Scenarios".

[4] ETSI TS 102 636-3: "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 3: Network architecture".

[5] ETSI EN 302 636-4-1: "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 4: Geographical addressing and forwarding for point-to-point and point-to-multipoint communications; Sub-part 1: Media-Independent Functionality".

2.2 Informative references

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

[i.1] ETSI EN 302 663: "Intelligent Transport Systems (ITS); Access layer specification for Intelligent Transport Systems operating in the 5 GHz frequency band".

[i.2] ETSI TS 102 636-4-2: "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 4: Geographical addressing and forwarding for point-to-point and point-to-multipoint communications; Sub-part 2: Media-dependent functionalities for ITS-G5".

[i.3] ETSI EN 302 637-2: "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 2: Specification of Cooperative Awareness Basic Service".

[i.4] ETSI EN 302 637-3: "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 3: Specifications of Decentralized Environmental Notification Basic Service".

[i.5] ETSI TS 102 890-2: "Intelligent Transport Systems (ITS); Facilities layer function; Part 2: Services announcement specification".

[i.6] IETF RFC 768: "User Datagram Protocol".

[i.7] ISO/IEC 8802-2: "Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements; Part 2: Logical Link Control".

[i.8] ISO EN 17419: "Intelligent Transport Systems - Cooperative Systems - Classification and management of ITS applications in a global context".

[i.9] ISO TS 19091: "Intelligent transport systems - Cooperative Systems - SPAT (Signal Phase and Timing) message, MAP (Intersection topology) message harmonization and profile to SAE J2735".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in ETSI EN 302 665 [1], ETSI TS 102 636-3 [4] and the following apply:

BTP-PDU: protocol Protocol Data Unit exchanged between BTP peer entities

destination: receiving BTP entity in the ITS station

destination port: port at which the destination is expected to listen for a BTP packet

GN-PDU: protocol Data Unit exchanged between peer entities of the GeoNetworking protocol

ITS-FPCI: protocol Control Information passed from the ITS Facilities layer to the BTP

port: ITS station-internal address that identifies a protocol entity at the ITS facilities layer and represents an endpoint of a logical connection

source: originating BTP entity in the ITS station

source port: port identifying the originating protocol entity at the ITS facilities layer

NOTE: Such an entity may be listening for a reply BTP packet.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI EN 302 665 [1], ETSI TS 102 636-3 [4] and the following apply:

BTP	Basic Transport Protocol
BTP-PDU	Basic Transport Protocol Protocol Data Unit
GN-PDU	GeoNetworking protocol PDU exchanged between peer entities of the GeoNetworking protocol
ITS-FPCI	ITS Facility layer Protocol Control Information
ITS-FPDU	ITS Facilities layer Protocol Data Unit
ITS-FSDU	ITS Facilities layer Service Data Unit
PCI	Protocol Control Information

4 Services provided by the Basic Transport Protocol

The Basic Transport Protocol (BTP) provides an end-to-end, connection-less transport service in the ITS ad hoc network (ETSI TS 102 636-3 [4]). Similar to UDP (RFC 768 [i.6]), it offers a minimal transport service, i.e. the non-guaranteed delivery of BTP-PDUs among BTP entities. It also allows protocol entities at the ITS facilities layer to directly access the services provided by the GeoNetworking protocol.

The BTP shall meet the requirements specified in ETSI EN 302 636-1 [2] and support the use cases defined in ETSI EN 302 636-2 [3].

The BTP provides services to ITS facilities layer protocol entities (figure 1), such as cooperative awareness basic service (ETSI EN 302 637-2 [i.3]) and DEN basic service (ETSI EN 302 637-3 [i.4]). The services are provided via the BTP-SAP using service primitives of different types that carry parameters, i.e. Protocol Control Information (ITS-FPCI), and the PDU of the upper protocol entity, i.e. ITS-FPDU. In order to provide its packet transport services, BTP uses the services of the GeoNetworking protocol (ETSI EN 302 636-4-1 [5]).

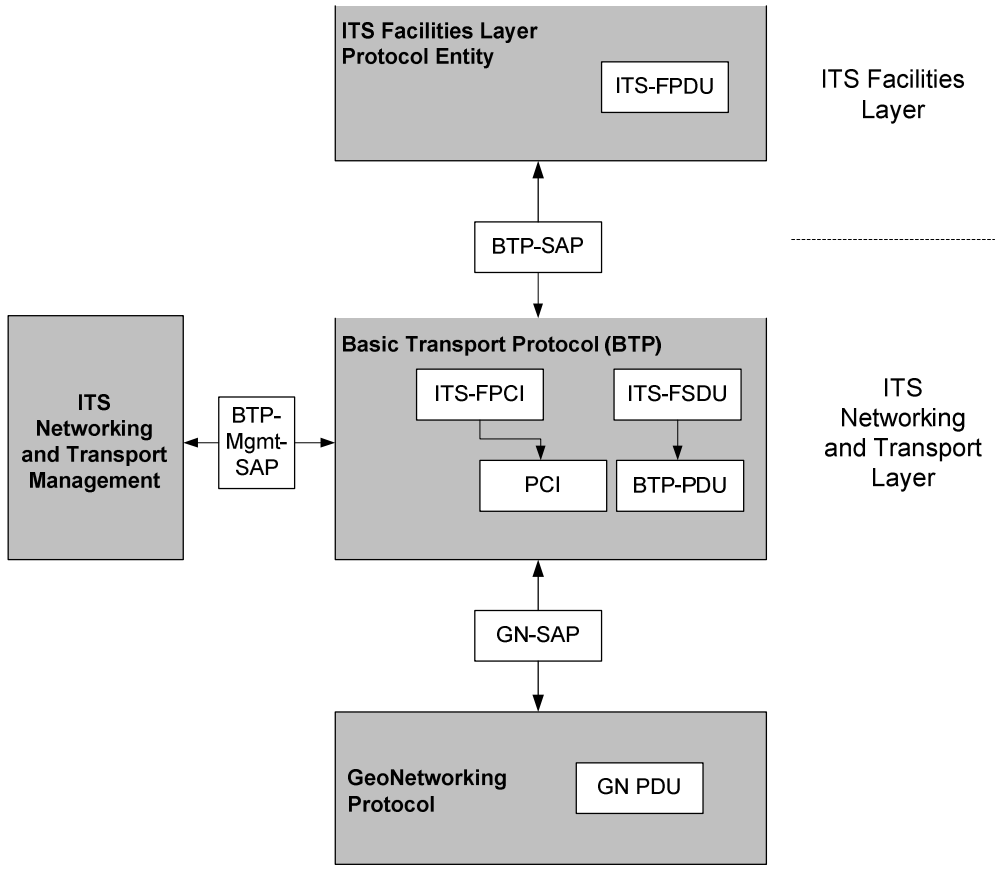

Figure 1: SAPs, SDUs and PDUs relevant for the BTP

The present document specifies the following SAPs:

- BTP-SAP between BTP and the ITS facilities layer; and
- BTP-Mgmt-SAP between the BTP and the ITS Network and Transport Management.

5 Format convention

The basic convention for the specification of packet formats is illustrated in figure 2. The bits are grouped into octets. The bits of an octet are always shown horizontally and are numbered from 0 to 7. Up to 4 octets are shown horizontally; multiple sets of 4 octets are grouped vertically. Octets are numbered from 0 to N-1.

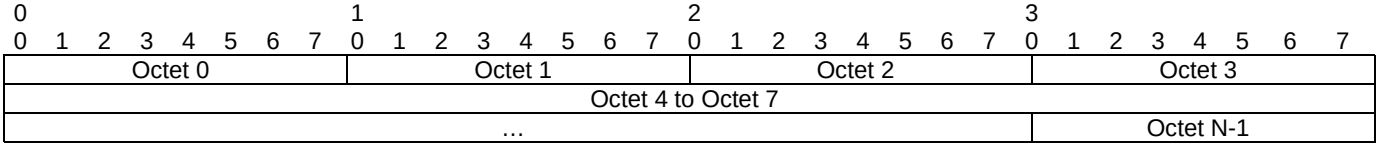

Figure 2: Format convention

When (a part of) an octet represents a numeric quantity, the leftmost bit in the diagram is the most significant bit. Similarly when a numeric value spans multiple octet fields the leftmost field is the most significant (i.e. Big Endian or Network Byte Order).

EXAMPLE: The decimal value 199 is represented as shown below:

0	1	2	3	4	5	6	7
1	1	0	0	0	1	1	1

6 BTP packet structure

As specified in ETSI TS 102 636-3 [4], the BTP is used in the GeoNetwork protocol stack (ETSI TS 102 636-3 [4], clause 7.3.2).

A BTP packet shall be comprised of the protocol headers and the payload as depicted in figure 3:

- The MAC header is the header of the MAC protocol of the ITS access technology. The MAC protocol can add additional protocol elements, such as a trailer for the MAC FCS as in ITS-G5 (ETSI EN 302 663 [i.1]).
- The LLC header is the header of 802.2 LLC/SNAP specified in ISO/IEC 8802-2 [i.7].
- The GeoNetworking header is the header of the GeoNetworking packet with an optional security header as defined in ETSI EN 302 636-4-1 [5] and extended for media-dependent GeoNetworking functionality, such as for ITS-G5, specified in ETSI TS 102 636-4-2 [i.2].
- The BTP header is the header of the Basic Transport Protocol as defined in the present document.
- The payload represents the user data that is created by upper protocol entities, i.e. the ITS-FSDU, and passed to the BTP entity for transmission.

NOTE: The general packet structure is shown as seen by the MAC protocol of the ITS access technology layer.

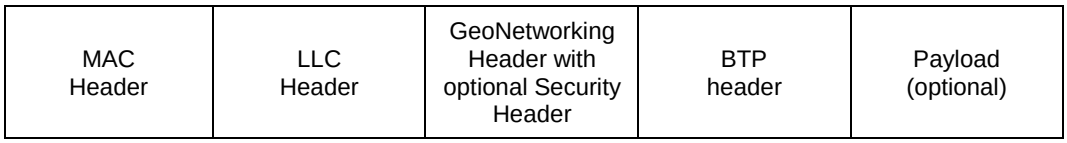

Figure 3: BTP packet structure

7 BTP header

7.1 Overview

BTP defines two protocol headers:

- BTP-A for interactive packet transport; and
- BTP-B for non-interactive packet transport.

The headers are distinguished by the *Next Header* field in the GeoNetworking header (ETSI EN 302 636-4-1 [5]) as illustrated in table 1.

Table 1: Encoding of BTP header types in the Next Header (NH) field of the GeoNetworking *Common Header*

Next Header (NH)	Encoding	Description
BTP-A	1	BTP-A header
BTP-B	2	BTP-B header

NOTE: The encoding of the Next Header field is specified in ETSI EN 302 636-4-1 [5]. In case of conflict in the encoding, ETSI EN 302 636-4-1 [5] takes precedence.

7.2 BTP-A header

7.2.1 Structure of the BTP-A header

The BTP-A header carries the source and the destination port (figure 4). The destination port identifies the protocol entity at the ITS facilities layer in the destination of a BTP-PDU. The source port indicates the port that the ITS facilities layer protocol entity in the source has used to send the ITS-FSDU. The source port represents the port to which a reply to the BTP PDU should be addressed in the absence of other information.

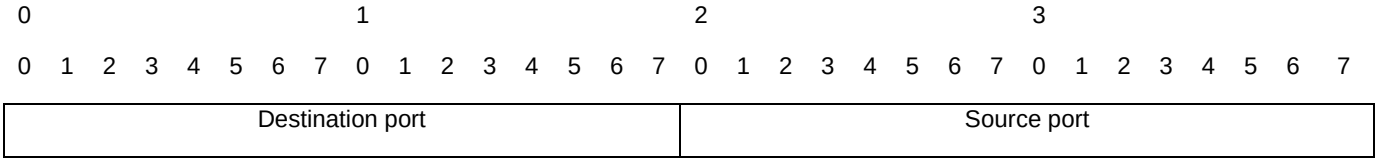

Figure 4: BTP-A header format

7.2.2 Fields of the BTP-A header

The BTP header shall carry the fields as specified in table 2.

Table 2: Fields of BTP-A header

Field #	Field name	Octet position		Type	Unit	Description
		First	Last			
1	*Destination port*	0	1	16 bit integer		Identifies the protocol entity at the destination's ITS facilities layer.
2	*Source port*	2	3	16 bit integer		Identifies the port of the protocol entity at the source's ITS facilities layer.

7.3 BTP-B header

7.3.1 Structure of the BTP-B header

The BTP-B header carries the destination port, but no source port (figure 5). The destination port identifies the protocol entity at the ITS facilities layer in the destination of a BTP-PDU and shall be set to the values in annex B, table B.1. The destination protocol provides additional info if *Destination port* is a well-known port. Setting is beyond the scope of the present document, default setting is 0.

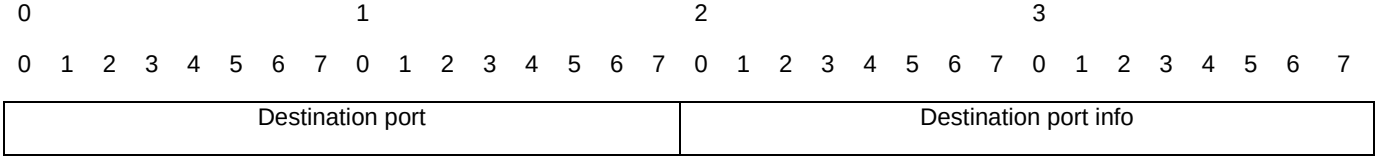

Figure 5: BTP-B header format

7.3.2 Fields of the BTP-B header

The BTP-B header shall carry the fields as specified in table 3.

Table 3: Fields of BTP-B header

Field #	Field name	Octet position		Type	Unit	Description
		First	Last			
1	*Destination port*	0	1	16 bit integer		Identifies the protocol entity at the ITS facilities layer in the destination and shall be set to the values in annex B, table B.1.
2	*Destination port info*	2	3	16 bit integer		Provides additional info if *Destination port* is a well-known port. Setting is beyond the scope of the present document, default setting is 0.

8 Protocol operations

8.1 General

This clause specifies the operations of a BTP entity for sending and receiving a BTP-PDU.

8.2 Source operations

On reception of a *BTP-Data.request* primitive, the source shall execute the following operations:

1) create a BTP-PDU with the ITS-FSDU as payload and a BTP packet header (clause 7):

   a) if the BTP type parameter in the *BTP-Data.request* primitive is BTP-A, set the BTP header fields as specified in table 4;

Table 4: Field settings for the BTP-A header

Field name	Field setting	Description
Source port	Value of Source port parameter from the BTP-Data.request primitive	Identifies the port of the protocol entity at the source's ITS facilities layer in the source of the BTP PDU.
Destination port	Value of Destination port parameter from the BTP-Data.request primitive	Identifies the protocol entity at the destination ITS facilities layer.

   b) if the BTP type parameter in the *BTP-Data.request* primitive is BTP-B, set the BTP header fields as specified in table 5;

Table 5: Field settings for the BTP-B header

Field name	Field setting	Description
Destination port	Value of Destination port parameter from the BTP-Data.request primitive	Identifies the protocol entity at the destination ITS facilities layer and shall be set to the values in annex B, table B.1.
Destination port info	Value of Destination port info parameter from the BTP-Data.request primitive	Provides additional info if Destination port is a well-known port. Setting is beyond the scope of the present document, default setting is 0.

2) pass the BTP-PDU to the GeoNetworking protocol entity via the GN_SAP by means of a *GN-Data.request* primitive with the parameter settings in table 6.

Table 6: Parameter settings in the *GN-Data.request* primitive to request sending a GeoNetworking packet

Parameter name	Parameter setting
Upper protocol entity	BTP
Packet transport type	Value of *BTP-Data.request* parameter *GN Packet transport type.*
Destination address	Value of *BTP-Data.request* parameter *GN Destination address.*
Communication profile	Value of *BTP-Data.request* parameter *Communication profile.*
Maximum packet lifetime	Value of *BTP-Data.request* parameter *Maximum packet lifetime.* Omitted if not used in *BTP-Data.request*.
Maximum repetition time	Value of *BTP-Data.request* parameter *Maximum repetition time.* Omitted if not used in *BTP-Data.request*.
Repetition interval	Value of *BTP-Data.request* parameter *Repetition interval* Omitted if not used in *BTP-Data.request*.
Traffic class	Value of *BTP-Data.request* parameter *Traffic class.*
Length	Length of [ITS-FSDU +4].
Data	BTP-SDU payload.

8.3 Destination operations

On reception of a BTP-PDU via the *GN-Data.indication* primitive, the destination shall pass the payload of the BTP-PDU via the BTP-SAP by means of a *BTP-Data.indication* with the parameter settings in table 7.

Table 7: Parameter settings in the *GN-Data.indication* primitive to indicate the reception of a BTP PDU

Parameter name	Parameter setting
Source port	If BTP header type is BTP-A, set to *Source port* in the BTP-A header. If BTP header type is BTP-B, omit this parameter.
Destination port	Set to *Destination port* in the BTP-A or BTP-B header.
Destination port info	If BTP header type is BTP-A, omit this parameter. If BTP header type is BTP-B, set to *Destination port* info in BTP-B header.
GN Packet transport type	Value of *GN-Data.indication* parameter *GN Packet transport type*.
GN Destination address	Value of *GN-Data.indication* parameter *GN Destination address*.
GN Source position vector	Value of *GN-Data.indication* parameter *Source position vector*.
GN Traffic class	Value *GN-Data.indication* parameter *Traffic class*. Omitted if not used in GN-Data.indication.
GN Remaining packet lifetime	Value of *GN-Data.indication* parameter *Remaining packet lifetime.* Omitted if not used in GN-Data.indication.
Length	Length of [GN-PDU payload - 4].
Data	BTP-PDU payload.

Annex A (informative): BTP data services

A.1 General

The BTP data service primitives allow entities of ITS Facilities protocols to send and receive PDUs via the BTP-SAP.

A.2 BTP-Data.request

The **BTP-Data.request** primitive is used by the ITS Facilities protocol entity to request sending a BTP-PDU. Upon reception of the **BTP-Data.request** primitive, the BTP protocol delivers the BTP-SDU to the GeoNetworking protocol entity via the GN-SAP.

The parameters of the **BTP-Data.request** are as follows:

BTP-Data.request (
BTP type,
Source port, (optional)
Destination port,
Destination port info, (optional)
GN Packet transport type,
GN Destination address,
GN Communication profile,
GN Security profile, (optional)
GN Maximum packet lifetime, (optional)
GN Repetition interval, (optional)
GN Maximum repetition time, (optional)
GN Maximum hop limit, (optional)
GN Traffic class,
Length,
Data
)

NOTE: *GN* in the primitive parameters indicates that this parameter is passed to the GeoNetworking protocol entity via the GN_SAP without being used by BTP.

The *BTP type* parameter specifies whether the BTP is interactive (BTP-A) or non-interactive (BTP-B).

The *Source port* parameter specifies the BTP port that is used to send the ITS-FSDU and is the port to which a reply should be sent in the absence of other information. The *Source port* parameter is optional and is only used for interactive packet transport (BTP-A).

The *Destination port* parameter specifies the BTP port at the destination.

The *Destination port info* parameter specifies additional information for the destination port if the port is a well-known port.

The *GN Packet transport type* parameter specifies the packet transport type (GeoUnicast, SHB, TSB, GeoBroadcast, GeoAnycast).

The *GN Destination address* parameter specifies the destination address for GeoUnicast or the geographical area for GeoBroadcast/GeoAnycast.

The *GN Communication profile* parameter determines the LL protocol entity (unspecified, ITS-G5A).

The *GN Security profile* parameter determines the security service to invoke.

The *GN Maximum packet lifetime* parameter specifies the maximum tolerable time in [s] a GeoNetworking packet can be buffered until it reaches its destination. The parameter is optional.

The *GN Repetition interval* parameter specifies the duration between two consecutive transmissions of the same GeoNetworking packet in [ms] during the repetition time. The parameter is optional. If it is not used, the packet is not repeated.

The *GN Maximum repetition time* parameter specifies the time in [s] a GeoNetworking packet is repeated. The parameter is optional; if the Repetition interval is not used, it is omitted

The *GN Maximum hop limit* specifies the number of hops a packet is allowed to have in the network, i.e. how often the packet is allowed to be forwarded.

The *GN Traffic class* parameter specifies the traffic class for the message.

The *Length* parameter indicates the length of the *Data* parameter.

The *Data* parameter represents the payload of the BTP packet to be transmitted, i.e. the ITS-FPDU.

A.3 BTP-Data.indication

The *BTP-Data.indication* primitive indicates to an ITS facilities layer protocol entity that a ITS-FSDU has been received. The ITS-FSDU is processed as determined by the receiving upper protocol entity.

The parameters of the BTP-Data.indication primitive are as follows:

BTP-Data.indication (
Source port, (optional)
Destination port,
Destination port info, (optional)
GN Destination address,
GN Source position vector,
GN Security report, (optional)
GN Certificate id, (optional)
GN Permissions, (optional)
GN Traffic class,
GN Remaining packet lifetime, (optional)
Length,
Data
)

NOTE: *GN* in the primitive parameters indicates that this parameter is passed to the ITS facilities layer protocol entity via the BTP_SAP without being used by BTP.

The *Source port* parameter specifies the BTP port that is used to send the ITS-FSDU and is the port to which a reply should be sent in the absence of other information. The *Source port* parameter is optional and is only used for interactive packet transport (BTP-A).

The *Destination port* parameter specifies the BTP port at the destination.

The *Destination port info* parameter specifies additional information for the destination port if the port is a well-known port.

The *GN Destination address* parameter specifies the destination address for GeoUnicast or the geographical area for GeoBroadcast/GeoAnycast, with which the GeoNetworking packet was generated by the source.

The *GN Source position vector* parameter specifies the GeoNetworking address, geographical position and optionally other parameters of the source of the received GeoNetworking packet.

The *GN Security report* contains result information from the security operations for decryption and verification (parameter report in the service primitive SN-DECAP.confirm).

The *GN Certificate id* contains the identification of source certificate, for example the ce rtificate hash (parameter certificate_id in the service primitive SN-DECAP.confirm).

The *GN Permissions* parameter contains the sender permissions (parameter permissions in the service primitive SN-DECAP.confirm).

The *GN Traffic Class* parameters is the traffic class, with which the GeoNetworking packet was generated by the source.

The *GN Remaining packet lifetime* parameter is the remaining lifetime of the packet.

The *Length* parameter indicates the length of the *Data* parameter.

The *Data* parameter represents the payload of the received BTP packet, i.e. the ITS-FPDU.

Annex B (normative): Well-known BTP port numbers

The well-known port numbers listed in table B.1 shall be used by ITS facilities layer entities.

Table B.1: List of well-known BTP port numbers

Well-known BTP port	ITS facilities layer entity	Related standard of the ITS facilities layer entity
2001	CAM	ETSI EN 302 637-2 [i.3]
2002	DENM	ETSI EN 302 637-3 [i.4]
2003	MAP	ISO TS 19091 [i.9]
2004	SPAT	ISO TS 19091 [i.9]
2005	SAM	ETSI TS 102 890-2 [i.5]

NOTE 1: The list of well-known BTP port numbers need to be updated with the progressing standardization of ITS facilities entities.

NOTE 2: When a global registration authority for ITS application as specified in ISO EN 17419 [i.8] is operational, the BTP destination port registered with this authority should be used.

Annex C (informative): Bibliography

EU FP7 GEONET Project: "Deliverable D2.2 Final GeoNet Specification", Version 1.1 January 2010.

SIM TD Project: "Deliverable D21.4 Spezifikation der Kommunikationsprotokolle", September 2009.

NOTE: Available at http://www.simtd.de.

DRIVE C2X Project "DRIVE C2X Enhanced System Specification", D23.1, Version 1.0, November 2011.

NOTE: Available at http://www.drive-c2x.eu/project.

History

Document history				
V1.1.1	February 2011	Publication as TS 102 636-5-1		
V1.2.0	October 2013	EN Approval Procedure	AP 20140201:	2013-10-04 to 2014-02-03
V1.2.1	May 2014	Vote	V 20140712:	2014-05-13 to 2014-07-14