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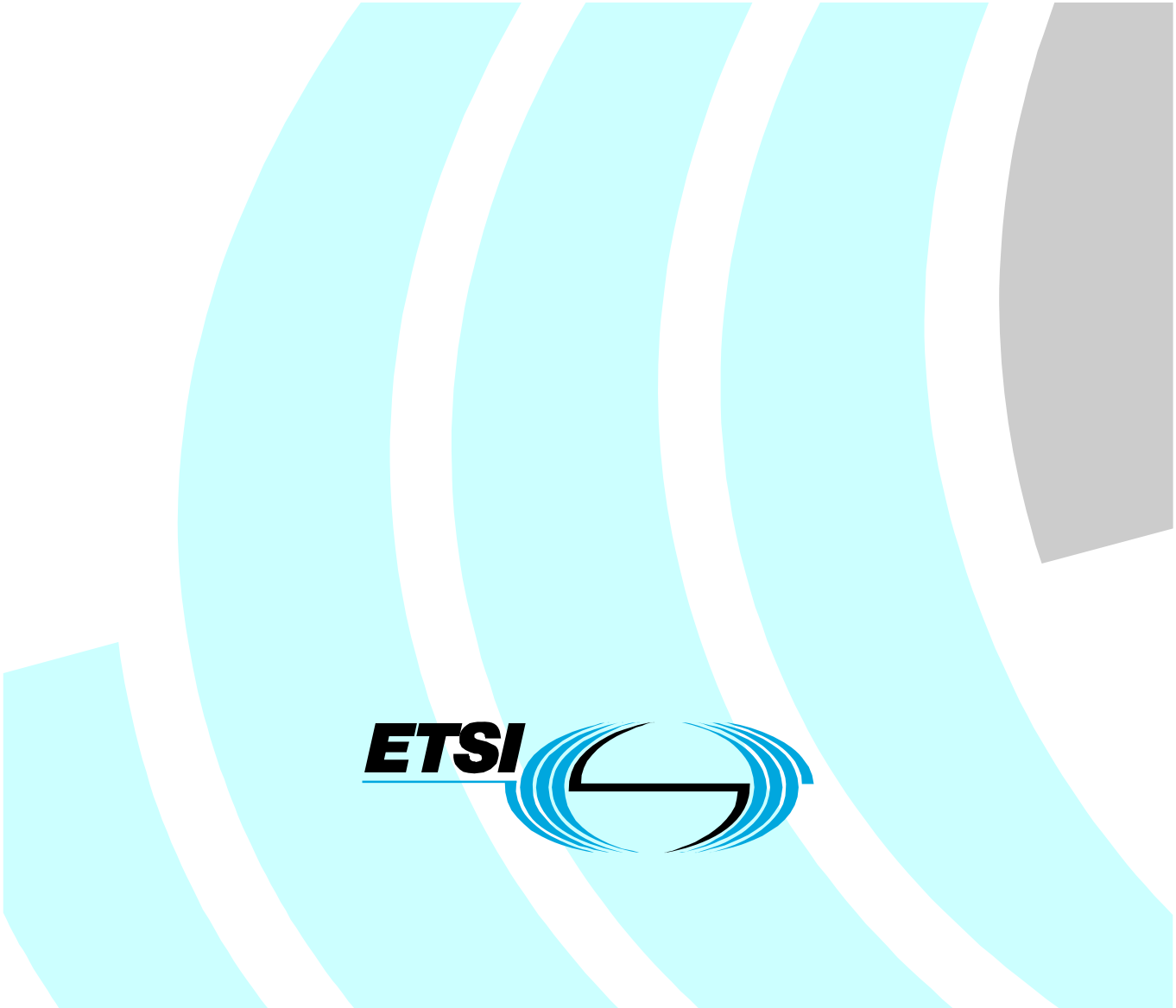
Technical Specification

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



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Contents

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Intelligent Transport System (ITS).

The present document is part 5, sub-part 1 of a multi-part deliverable covering Networking and Transport, as identified below:

Part 1: "Requirements";

Part 2: "Scenarios";

Part 3: "Network architecture";

Part 4: "Geographical addressing and forwarding for point-to-point and point-to-multipoint communications";

Part 5: "Transport Protocols":

Sub-part 1: "Basic Transport Protocol";

Part 6: "Internet Integration".

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 DEN services, for the transmission of packets via the GeoNetworking protocol as well as the de-multiplexing at the destination). BTP enables the 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) and 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 UDP the multiplexing/demultiplexing of 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 packet to the entities at the ITS Facilities layer. BTP also adopts the concept of "well-known ports" from the IP protocol suites that assigns fixed ports to specific ITS Facilities layer protocols. The definition of the ports, however, is beyond the scope of the present standard.

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 ITS Basic Transport Protocol (BTP) for the transport of packets among ITS stations in the ITS ad hoc network. 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 TS 102 636-1: "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 1: Requirements".

[3] ETSI TS 102 636-2: "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".

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 ES 202 663: "Intelligent Transport Systems (ITS); European profile standard for the physical and medium access control layer of Intelligent Transport Systems operating in the 5 GHz frequency band".

[i.2] ETSI TS 102 636-4-1: "Intelligent Transport System (ITS); Vehicular communications; GeoNetworking; Part 4: Geographical addressing and forwarding for point-to-point and point-to-multipoint communications; Sub-part 1: Media independent functionalities".

[i.3] 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-G5A media".

[i.4] ETSI TS 102 637-2: "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 2: Specification of Cooperative Awareness Basic Service".

[i.5] IETF RFC 768: "User Datagram Protocol".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in [1], [4] and the following apply:

destination: receiving BTP entity in the ITS station

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

port: ITS station-internal address that identifies a protocol entity at the ITS facilities layer

source: originating BTP entity in the ITS station

source port: port at which the source of the BTP packet is listening for a reply BTP packet

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in [1], [4] and the following apply:

BTP	Basic Transport Protocol
FL	Facilities Layer

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 [4]. Similar to UDP [i.5], 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 [2] and support the use cases defined in [3].

The BTP provides services to ITS Facilities Layer protocol entities (figure 1), such as CAM [i.4] and DENM [4]. The services are provided via the BTP-SAP using service primitives of different types that carry parameters and the PDU of the upper protocol entity, i.e. FL-PDU. In order to provide its packet transport services, BTP uses the services of the GeoNetworking protocol [i.3].

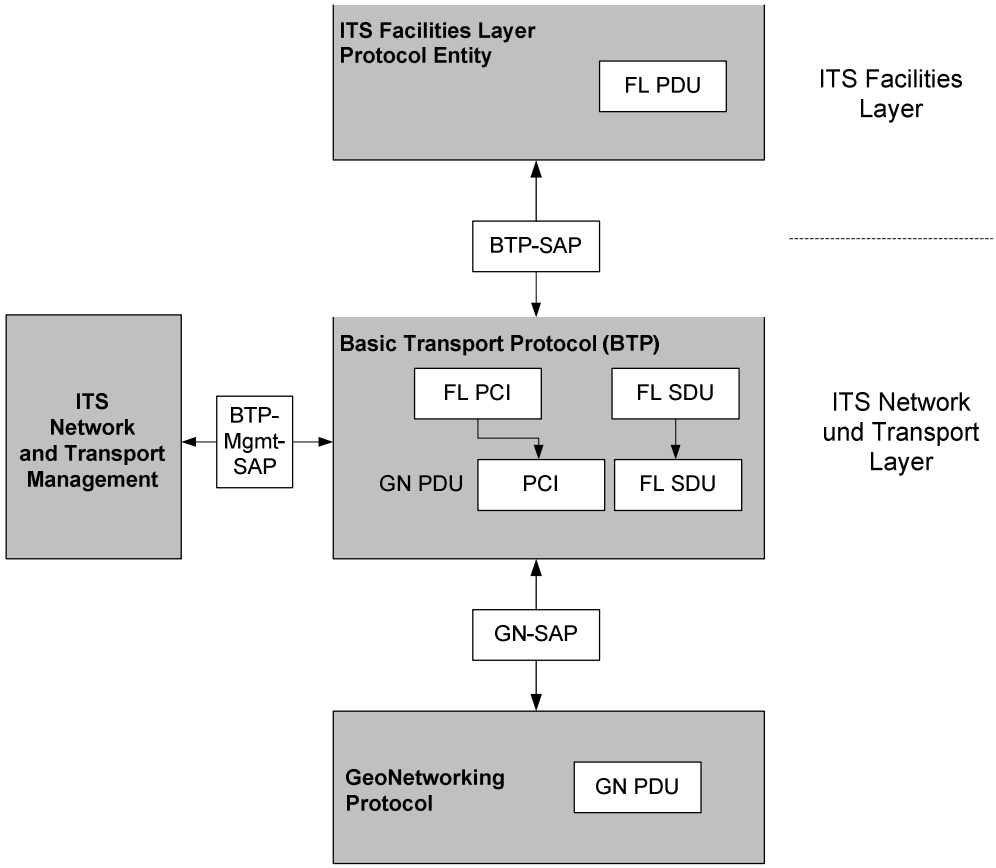

Figure 1: SAPs, SDUs and PDUs relevant for the BTP

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 present specification is illustrated in figure 2. The bits are grouped into bytes. 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.

The octets are transmitted in ascending numerical order; inside an octet the bit 0 is transmitted first.

When a field is contained within a single octet, the highest bit number of the field represents the lowest order value.

When a field spans more than one octet, the order of bit values within each octet progressively increases as the octet number increases (network byte order).

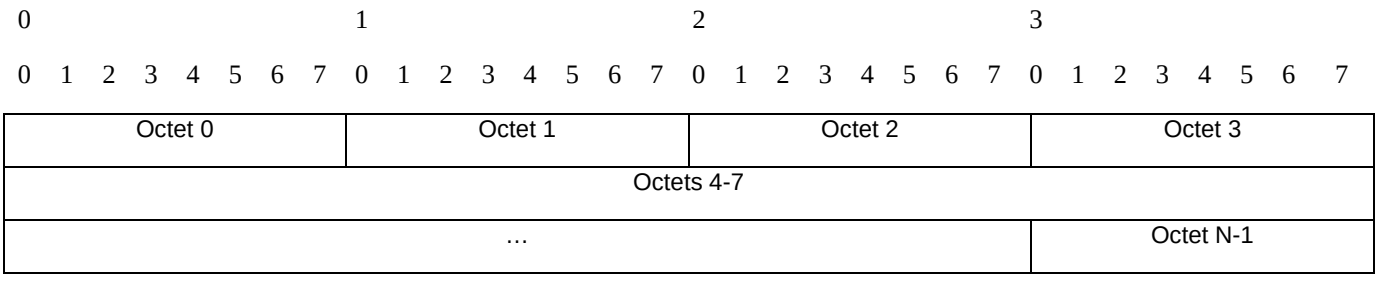

Figure 2: Format convention

6 BTP packet structure

As specified in TS 102 636-3 [4], the BTP is used in the GeoNetwork protocol stack (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 [i.1].
- The GeoNetworking header is the header of the GeoNetworking packet as defined in the present document and extended for media-dependent GeoNetworking functionality, such as for ITS-G5A specified in TS 102 636-4-2 [i.3].
- The optional GeoNetworking security header.
- The BTP header is the header of the Basic Transport Protocol as defined in the present document.
- The payload represents the user data that are created by upper protocol entities, i.e. the FL-SDU, 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.

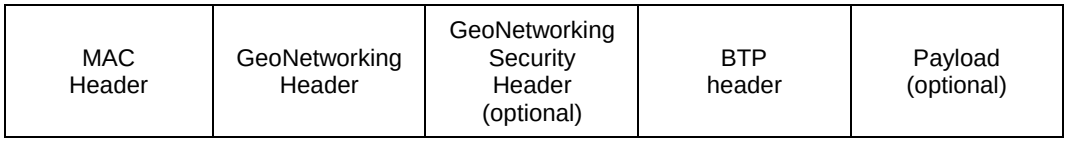

Figure 3: BTP packet structure

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 [i.2] 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

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 Facility layer in the destination of a BTP-PDU. The source port indicates the port that the ITS Facility layer protocol entity in the source has used to send the FL-SDU. The source port represents the port to which a reply to the BTP PDU should be addressed in the absence of other information.

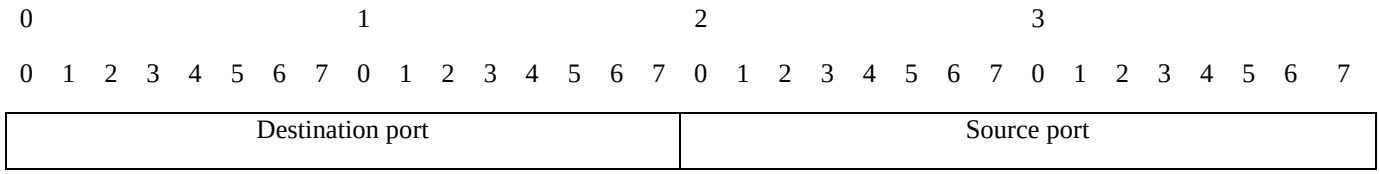

Figure 4: BTP-A header format

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 Facility layer.
2	*Source port*	2	3	16 bit integer		Identifies the port of the protocol entity at the source's ITS Facility layer in the source of the BTP PDU.

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 Facility layer in the destination of a BTP-PDU. 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.

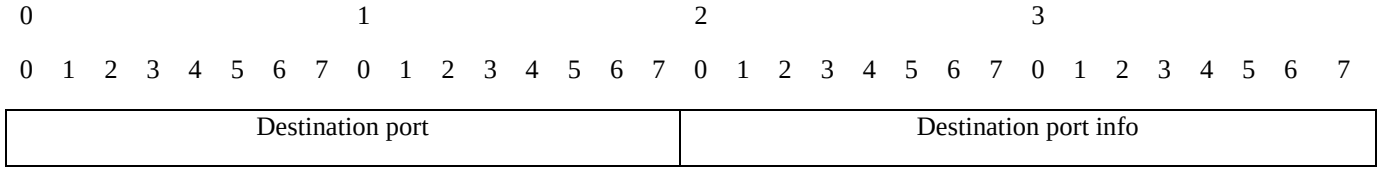

Figure 5: BTP-B header format

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 Facility layer in the destination.
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 FL-SDU as payload and a BTP packet header (clause 7.2):

   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 Facility 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 Facility 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 Facility layer.
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	Value of *BTP-Data.request* parameter *GN Destination*
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*.
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
Length	Length of [FL-SDU +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	Value of GN-Data.indication parameter GN Destination.
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,
GN Communication profile,
GN Maximum packet lifetime, (optional)
GN Repetition interval, (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 FL-SDU 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* 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 Maximum 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 during the lifetime of a packet in [ms]. The parameter is optional.

The *GN Traffic class* parameter specifies the traffic class for the message as a triple of Relevance, Reliability, and Latency.

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

The *Data* parameter represents the payload of the GeoNetworking packet to be transmitted, i.e. the T-PDU.

A.3 BTP-Data.indication

The *BTP-Data.indication* primitive indicates to an ITS Facilities layer protocol entity that a FL-SDU has been received. The FL-SDU 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 Packet transport type,
GN Destination,
GN Source position vector,
GN Traffic class,
GN Maximum packet lifetime,
Length,
Data
)

NOTE: *GN* in the primitive parameters indicates that this parameter is passed to the ITS Facility 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 FL-SDU 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) of the received BTP-PDU.

The *GN Destination* 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 geographical position for the source of the received GeoNetworking packet.

The *GN Maximum packet lifetime* and *Traffic Class* parameters specify the lifetime and traffic class, respectively, with which the GeoNetworking packet was generated by the source.

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

The *Data* parameter represents the payload of the received GeoNetworking packet, i.e. the T-PDU.

Annex B (informative): Bibliography

- EU FP7 GEONET Project: "Deliverable D2.2 Final GeoNet Specification", Version 1.1 January 2010, http://www.geonet-project.eu.
- SIM TD Project: "Deliverable D21.4 Spezifikation der Kommunikationsprotokolle", September 2009, http://www.simtd.de.

History

Document history		
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