INTERNATIONAL STANDARD

ISO 13400-2

Second edition
2019-12

AMENDMENT 1
2023-07

Road vehicles — Diagnostic communication over Internet Protocol (DoIP) —

Part 2: Transport protocol and network layer services

AMENDMENT 1

Véhicules routiers — Communication de diagnostic au travers du protocole internet (DoIP) —

Partie 2: Protocole de transport et services de la couche réseau

AMENDEMENT 1

Reference number
ISO 13400-2:2019/Amd.1:2023(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

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 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 31, *Data communication*.

A list of all parts in the ISO 13400 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Road vehicles — Diagnostic communication over Internet Protocol (DoIP) —

Part 2: Transport protocol and network layer services

AMENDMENT 1

6.2.5

Replace description with this text.

For a secured TCP connection, the TLS dedicated TCP_DATA port is used. As for the unsecured DoIP session case, the first step in order to initiate a secure TLS connection between the client DoIP entity and the DoIP entity, is to open a TLS socket (destination port is TLS TCP_DATA). This is done prior to any message exchange. Therefore, a DoIP entity provides the resources to handle the incoming communication request (e.g. socket resources). The DoIP entity provides sufficient resources to handle the specified number of concurrently supported DoIP sessions secured with TLS (<k>) (see [DoIP-159]). If more than <k> connection attempts arrive at the same time, it is possible that no more resources are available and the <k + 1st> connection attempt is refused (because there are no longer any sockets in the listening state because of DoIP protocol handling).

A vehicle manufacturer may choose to implement k+1 TLS data sockets, where the additional socket is used to reject a routing activation with routing activation response code 01_{16}.

If a k+1 TLS data socket is not implemented, no DoIP routing activation response code 01_{16} can be responded when all k concurrently supported DoIP sessions are already in use. In this case, the additional connection will be rejected on the TCP level already.

7.7, Table 12

Replace Table 12 with this table.

Table 12 — DoIP timing and communication parameters

Timing parameter	Description	Client	Server
$t_{A\_DoIP\_Ctrl}$	This timeout specifies the time that the client DoIP entity waits for a response to a previously sent UDP message. This includes the time to wait and collect multiple responses to a previous broadcast (UDP only).	Minimum timeout: 2 s	Recommended ECU Performance Response time: 1 600 ms
$t_{A\_DoIP\_Routing\_Activation}$	This timeout specifies the time that the client DoIP entity waits for a response to a previously sent routing activation request on a TCP_DATA socket.	Minimum timeout: 2 s	Recommended ECU Performance Response time: 1 600 ms

Table 12 *(continued)*

Timing parameter	Description	Client	Server
$t_{A\_DoIP\_Announce\_Wait}$	This timing parameter specifies the initial time that a DoIP entity waits until it responds to a vehicle identification request and the time that a DoIP entity waits until it transmits a vehicle announcement message after a valid IP address is configured. The value of this timing parameter shall be determined randomly between the minimum and the maximum value.	N/A	Random time: 0 to 500 ms
$t_{A\_DoIP\_Announce\_Interval}$	This timing parameter specifies the time between the vehicle announcement messages that are sent by the DoIP entities after a valid IP address has been configured.	N/A	Delay time: 500 ms
$t_{A\_DoIP\_Announce\_Num}$	This parameter specifies the number of vehicle-announcement messages, which are sent by the DoIP entity, after the configuration of a valid IP address.	N/A	Repetition: 3 times
$t_{A\_DoIP\_Diagnostic\_Message}$	This is the time between receipt of the last byte of a DoIP diagnostic message and the transmission of the confirmation ACK or NACK. After the timeout has elapsed, the request or the response shall be considered lost and the request may be repeated.	Minimum timeout: 2 s	ECU performance response time: 50 ms
$t_{T\_TCP\_General\_Inactivity}$	This timeout specifies the time of inactivity on a TCP_DATA socket (no data received or sent) before it is closed by the DoIP entity.	N/A	Timeout: 300 s
$t_{T\_TCP\_Initial\_Inactivity}$	This timeout specifies the time of inactivity directly after a TCP_DATA socket is established. After the specified time without routing activation, the TCP_DATA socket is closed by the DoIP entity.	N/A	Timeout: 2 s
$t_{T\_TCP\_Alive\_Check}$	This timeout specifies the time that a DoIP entity waits for an alive check response after having written an alive check request on the TCP_DATA socket. Thus, the timer elapses if the underlying TCP stack is unable to deliver the alive check request message.	Client performance time: 300 ms	Timeout: 500 ms
$t_{A\_Processing\_Time}$	This timeout is defined as the time between transmission from the client DoIP entity of DoIP messages that require no response message but may need some time to be processed. Thus, the client DoIP entity shall wait for at least A_Processing_Time before sending another request to the same DoIP entity.	Timeout: 2 s	N/A
$t_{A\_Vehicle\_Discovery\_Timer}$	This is a per vehicle offboard sided timer. This timer specifies the time a vehicle can take to perform the VIN/GID synchronization between all DoIP entities. The vehicle discovery timer may only be started when a vehicle announcement/ vehicle identification response message containing a VIN/GID sync status code “incomplete” (10_{16}) and a valid VIN or GID is received by the client DoIP entity.	Timeout: 5 s	N/A

9.2, Table 16

Replace Table 16 with this table.

Table 16 — Generic DoIP header structure

Item	Pos.	Len.	Description	Values
Protocol version	0	1	Identifies the protocol version of DoIP packets.	00_{16}: reserved 01_{16}: ISO/DIS 13400-2:2010 02_{16}: ISO 13400-2:2012 03_{16}: ISO 13400-2:2019 04_{16}: ISO 13400-2:2019/Amd1 05_{16} to FE_{16}: reserved by this document FF_{16}: default value for vehicle identification request messages
Inverse protocol version	1	1	Contains the bit-wise inverse value of the protocol version, which is used in conjunction with the DoIP protocol version as a protocol verification pattern to ensure that a correctly formatted DoIP message is received.	Equals the <Protocol_Version> XOR FF_{16} (e.g. FE_{16} for protocol version 01_{16}).
Payload type (GH_PT)	2	2	Contains information about how to interpret the data following the generic DoIP header (e.g. gateway command, diagnostic message, etc.).	See Table 17 for a complete list of currently specified payload type values.
Payload length (GH_PL)	4	4	Contains the length of the DoIP message payload in bytes (i.e. excluding the generic DoIP header bytes). Some payload types do not require any additional parameters (payload length is 0), some require a fixed DoIP message length while others allow for dynamic length DoIP messages.	0 to 4 294 967 295 bytes
Payload type specific message content	8	…	The payload type specific message content starts here. This implies that, for example, byte position 0 of the payload type-specific part of the message means byte position 8 in the context of the overall DoIP message.	—

9.2, Table 17

Replace Table 17 with this table.

Table 17 — Overview of DoIP application layer payload types

Payload type		See	Support DoIP		Port and protocol
value	name		GW	nodes	
0000_{16}	Generic DoIP header negative acknowledge	9.3	M	M	UDP_DISCOVERY UDP_TEST_EQUIPMENT_REQUEST TCP_DATA
0001_{16}	Vehicle identification request message	7.4	M	M	UDP_DISCOVERY

Table 17 *(continued)*

Payload type		See	Support DoIP		Port and protocol
value	name		GW	nodes	
0002_{16}	Vehicle identification request message with EID	7.4	O	O	UDP_DISCOVERY
0003_{16}	Vehicle identification request message with VIN	7.4	M	M	UDP_DISCOVERY
0004_{16}	Vehicle announcement message/ vehicle identification response message	7.4	M	M	UDP_DISCOVERY UDP_TEST_EQUIPMENT_REQUEST
0005_{16}	Routing activation request	12.5	M	M	TCP_DATA
0006_{16}	Routing activation response	12.5	M	M	TCP_DATA
0007_{16}	Alive check request	9.6	M	M	TCP_DATA
0008_{16}	Alive check response	9.6	M	M	TCP_DATA
0009_{16} to 4000_{16}	reserved by this document				
4001_{16}	DoIP entity status request	7.6	O	O	UDP_DISCOVERY
4002_{16}	DoIP entity status response	7.6	O	O	UDP_TEST_EQUIPMENT_REQUEST
4003_{16}	Diagnostic power mode information request	7.5	M	M	UDP_DISCOVERY
4004_{16}	Diagnostic power mode information response	7.5	M	M	UDP_TEST_EQUIPMENT_REQUEST
4005_{16} to 8000_{16}	reserved by this document				
8001_{16}	Diagnostic message	9.5	M	M	TCP_DATA
8002_{16}	Diagnostic message positive acknowledgement	9.5	M	M	TCP_DATA
8003_{16}	Diagnostic message negative acknowledgement	9.5	M	M	TCP_DATA
8004_{16}	Periodic diagnostic message	9.7	O	O	TCP_DATA
8005_{16} to $8FFF_{16}$	reserved by this document				
9000_{16} to $9FFF_{16}$	see 11.4				
$A000_{16}$ to $EFFF_{16}$	reserved by this document				
$F000_{16}$ to $FFFF_{16}$	Reserved for manufacturer-specific use	—	O	O	—

9.2, Figure 16

Replace Figure 16 with this figure.

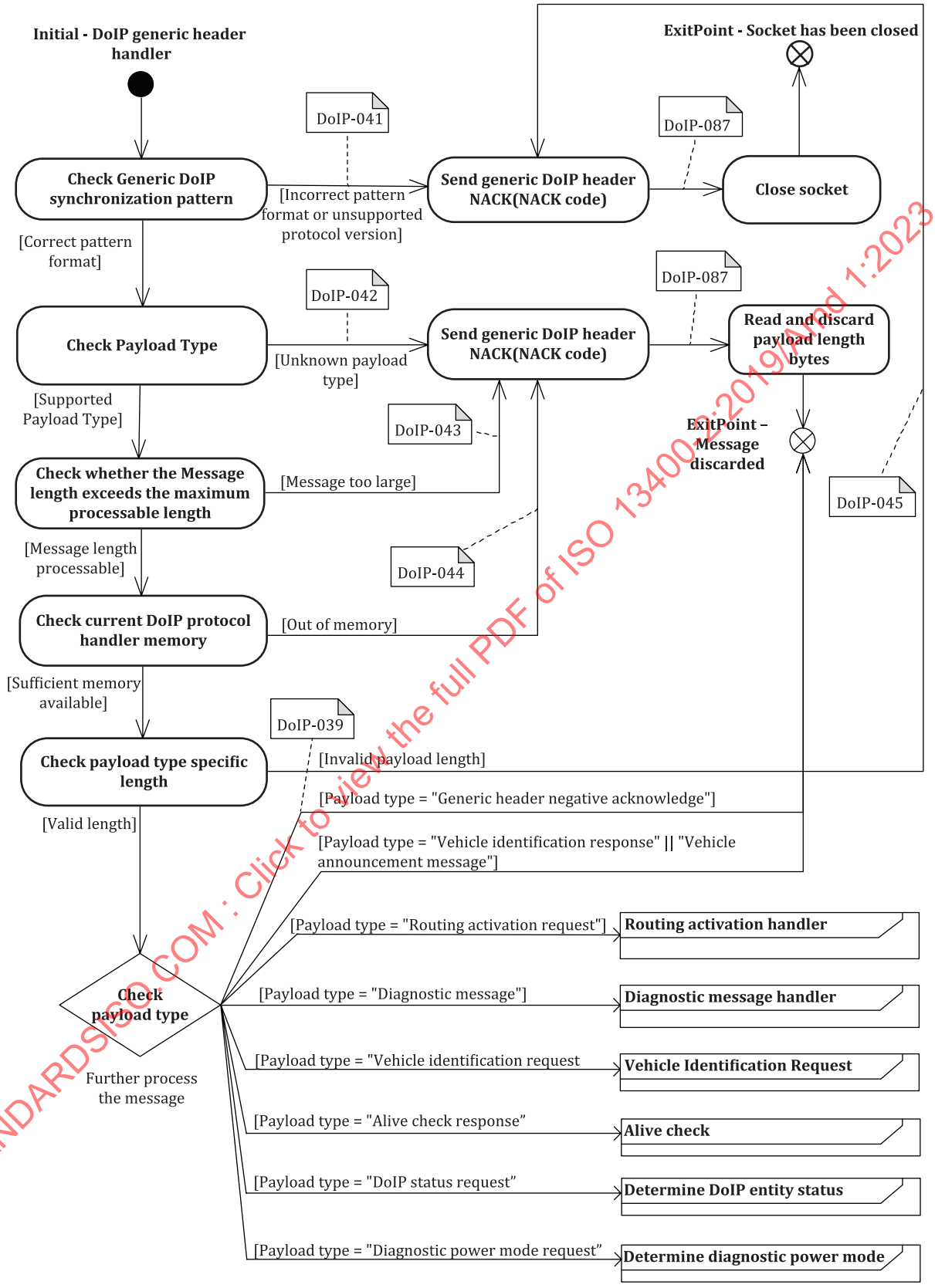


Figure 16 — DoIP generic header handler

9.2

Replace REQ 7.DoIP-041 AL with the following.

REQ	7.DoIP-041 AL – DoIP entity does not match generic DoIP header structure
Each DoIP entity shall send a generic DoIP header negative acknowledge message with NACK code set to 00_{16} if the protocol version or inverse protocol version (synchronization pattern) does not match the format specified in Table 16 or if the protocol version is not supported by the DOIP entity.	

9.4, NOTE 1

Replace NOTE 1 with the following:

NOTE 1 Table 20 shows the IPv6 variant. For IPv4, Limited Broadcast is used instead of Multicast.

9.5, title

Replace "AL diagnostic message and diagnostic message acknowledgement" with "AL – Payload type definition and acknowledgement".

9.5, first paragraph

Replace with the following:

This subclause specifies the message format that allows for the optional transmission of internal transport layer status service primitive information to a DoIP client. This transport layer status message covers the standard transport layer services primitives useful to the DoIP client including T_Data.confirm, T_DataSOM.indication, and T_Data.indication. If this payload type is utilized, a DoIP client has the ability to determine when a gatewayed message has completed transmission on the target network (or aborted due to an error), when a segmented response has started on the target network, and when a segmented response has aborted due to an error on the target network. DoIP clients are not required to process this payload type if supported by a DoIP entity. If a DoIP client does support processing this payload type, it may implement substantially faster timeouts depending upon the details of the target network.

9.5

Replace REQ 7.DoIP-064 AL with the following:

REQ	7.DoIP-064 AL – DoIP entity status message structure
Each DoIP entity shall support the status message structure as specified in Table 21 for incoming (i.e. requests) and outgoing (i.e. responses) diagnostic messages.	

9.7

Add the following new subclause.

9.7 AL – Periodic response message

This subclause specifies the periodic response message structure of the DoIP message that is used. The periodic response messages are utilized by the `TCP_DATA` socket handler.

REQ	7.DoIP-189 AL – DoIP periodic response message structure
For DoIP entities that use payload type 8004_{16}, each DoIP entity shall support the periodic response message structure as specified in Table 31.	

Insert new Tables 29-31.

Table 29 — Payload type periodic response message structure

Item	Pos.	Len.	Description	Values	Cvt
Protocol version	0	1	see Table 16	see Table 16	M
Inverse protocol version	1	1	see Table 16	see Table 16	M
Payload type (GH_PT)	2	2	see Table 16	see Table 16	M
Payload length (GH_PL)	4	4	see Table 16	see Table 16	M
Source address (SA)	8	2	Contains the logical address of the sender of a diagnostic message (e.g. the client DoIP entity address).	see Table 13	M
Target address (TA)	10	2	Contains the logical address of the receiver of a diagnostic message (e.g. a specific server DoIP entity on the vehicle's networks).	see Table 13	M
User data 1 to 9	12	9	Contains the actual timestamp of the user data 12 to 12 + k.	See Table 30	M
User data 10	21	2	Contains the periodic response payload length	0002_{16} to $FFFF_{16}$	M
User data 12	23	1	Contains the periodicDataIdentifier	00_{16} to FF_{16}	M
User data 13 to user data (12 + k)	24	k	Contains the dataRecord[] = [] data#1 : data#k]	 00_{16} to FF16 : 00_{16} to FF_{16}	M
:	:	:	:	:	:
User data t to t + 8	t	9	Contains the actual timestamp of the user data t to t + k.	See Table 30	C[a]
User data t + 9	t + 9	2	Contains the periodic response payload length	(p + 1) 0002_{16} to $FFFF_{16}$	C[a]
User data t + 11	t + 11	1	Contains the periodicDataIdentifier	00_{16} to FF_{16}	C[a]
User data t + 12 to user data (t + 11+p)	t + 12	p	Contains the dataRecord[] = [] data#1 : data#p]	 00_{16} to FF_{16} : 00_{16} to FF_{16}	C[a]

[a] Present, if more periodic responses are available to be reported from the same source address.

Table 30 — Timestamp format definition

Item	Pos.	Len.	Description	Type	Values	Cvt
Time base status	1	1	Synchronization state of the ECU's local time base with the vehicle's global time base.	see Table 31	see Table 31	M

Table 30 *(continued)*

Item	Pos.	Len.	Description	Type	Values	Cvt
Nanoseconds part of time	2	4	Minimum value Maximum value Least Significant bits below the resolution of the Local Time Base shall be padded with 0. Content of timestamp is not in the scope of this document.	UINT32	00000000_{16} $3B9AC9FF_{16}$	M
32-bit LSB of 48-bit seconds part of time	7	4	Date: 1970-01-01 (YYYY-MM-DD) Content of timestamp is not in the scope of this document.	UINT32	00000000_{16}	M

Table 31 — Time Base Status definition

Item	Bit	Len.	Description	Type	Values	Cvt
TIMEOUT	0	1	Timeout while waiting for time synchronization message. Synchronization message was received on time. Synchronization message was not received.	BOOL	 0_2 1_2	M
reserved by document	1	1	n/a	n/a	–	M
SYNC_TO_GATEWAY	2	1	Synchronization with time gateway. Local Time Base is synchronized with the Global Time Base. Local Time Base is synchronized with time gateway.	BOOL	 0_2 1_2	M
GLOBAL_TIME_BASE	3	1	Synchronization with Global Time Base. Local Time Base was never synchronized with the Global Time Base Local Time Base was synchronized with the Global Time Base.	BOOL	 0_2 1_2	M
TIMELEAP_FUTURE	4	1	Synchronization required a leap forward in time. Leap into the future within Time Base does not exceed threshold. Leap into the future within Time Base exceeds threshold.	BOOL	 0_2 1_2	M
TIMELEAP_PAST	5	1	Synchronization required a leap backwards in time. Leap into the past within Time Base does not exceed threshold. Leap into the past within Time Base exceeds threshold.	BOOL	 0_2 1_2	M
reserved by document	6	1	n/a	n/a	–	M
reserved by document	7	1	n/a	n/a	–	M

10.1

Former Table 29 is renumbered to Table 32.

All references to Table 29 are renumbered accordingly.

10.2.3

Former Table 30 is renumbered to Table 33.

Former Table 31 is renumbered to Table 34.

All references to Tables 30 and 31 are renumbered accordingly.

10.2.4

Former Table 32 is renumbered to Table 35.

Former Table 33 is renumbered to Table 36.

Former Table 34 is renumbered to Table 37.

Former Table 35 is renumbered to Table 38.

Former Table 36 is renumbered to Table 39.

Former Table 37 is renumbered to Table 40.

All references to Tables 32 to 37 are renumbered accordingly.

11.1

Former Table 38 is renumbered to Table 41.

Former Table 39 is renumbered to Table 42.

All references to Table 38 and 39 are renumbered accordingly.

11.2

Former Table 40 is renumbered to Table 43.

Former Table 41 is renumbered to Table 44.

All references to Table 40 and 41 are renumbered accordingly.

11.4

Add the following new subclause.

11.4 TL

11.4.1 TL – General

This subclause specifies the message format that allows for the optional transmission of internal transport protocol status service primitive information to a DoIP client. This transport protocol status covers the standard transport layer service primitives used by the DoIP client including `T_DATA.confirm`, `T_DATASOM.indication`, and `T_DATA.indication`. If this payload type is utilized, a DoIP client has the ability to determine when a gatewayed message has completed transmission on the target network (or aborted due to an error), when a segmented response has started on the target network, and when a segmented response has aborted due to an error on the target network.

DoIP clients are not required to process this payload type if supported by a DoIP entity. If a DoIP client does support processing this payload type, it may implement substantially faster timeouts depending upon the details of the target network.

11.4.2 TL – DoIP entity status message structure

REQ	4.DoIP-064 TL – DoIP entity status message structure
Each DoIP entity shall support the transport layer payload type message structure as specified in Table 44 for incoming (i.e. requests) and outgoing (i.e. responses) messages.	

Insert new Tables 45-48.

Table 45 — Overview of DoIP transport layer payload types

Payload type		Specified	Support DoIP		Port and protocol
value	name	in	gateways	nodes	
9000_{16}	reserved by this document	–	–	–	–
9001_{16}	transport layer payload type message structure	Table 44	0	0	`TCP_DATA`
9002_{16} to $9FFF_{16}$	reserved by this document	–	–	–	–

Table 46 — Transport layer payload type message structure

Item	Pos.	Len.	Description	Value	Cvt
Protocol version	0	1	see Table 16	see Table 16	M
Inverse protocol version	1	1	see Table 16	see Table 16	M
Payload type (GH_PT)	2	2	see Table 16	see Table 16	M
Payload length (GH_PL)	4	4	see Table 16	see Table 16	M
Source address (SA)	8	2	Contains the logical address of the sender of the transport layer status message (e.g., the target ECU entity address).	see Table 13	M
Target address (TA)	10	2	Contains the logical address of the receiver of the transport layer status message (e.g., the DoIP client which initiated the request)	see Table 13	M
TP status type value	12	1	The ISO 14229-2[4] transport layer status type being conveyed.	see Table 41c	M
TP status code value	13	1	The transport layer status code related to any error information associated with the transport protocol status type.	see Table 41d	M

Table 46 *(continued)*

Item	Pos.	Len.	Description	Value	Cvt
Application layer service	14	1	The application layer service that the transport layer status message corresponds to.	ISO 14229-1[3] service identifier or 00_{16} if not available or not applicable.	M

Table 47 — Transport layer status type values

Value	Symbol name	Description	Definition	Cvt
00_{16}	–	reserved by this document	–	M
01_{16}	TX_ST_TYPE	transmission confirmation with result	ISO 14229-2[4] T_DATA.conf [confirmation status with result of a transmitted message e.g., DoIP edge node to an internal Ethernet gateway to a server connected to the sub-network]	M
02_{16}	RX_ST_TYPE	reception indication with result	ISO 14229-2[4] T_DATA.ind [final indication status with result (non-zero code, see Table 46) about the abortion of message reception from a server on the sub-network]	M
03_{16}	SOM_ST_TYPE	StartOfMessage (SOM) indication with result	ISO 14229-2[4] T_DATASOM.ind [indication of start of message reception with result e.g., to the DoIP gateway from the sub-network server]	M
04_{16} to FF_{16}	–	reserved by this document	–	M

Table 48 — Transport layer status code values

Value	Symbol name	Description	Sub-network confirmation			Cvt
			TX_ST_TYPE	RX_ST_TYPE	SOM_ST_TYPE	
00_{16}	T_OK	service execution successful	a[a]	n/a[b]	a[a]	M
01_{16} to FE_{16}	T_RESULT	result code mapping from sub-network T_DATA protocol interface	–	–	–	–
FF_{16}	T_ERROR	general error	a[a]	a[a]	n/a[b]	M

[a] applicable

[b] not applicable

11.4.2

Add the following new Figure 22.

Former Figure 22 is renumbered to Figure 23.

Former Figure 23 is renumbered to Figure 24.

Former Figure 24 is renumbered to Figure 25.

Former Figure 25 is renumbered to Figure 26.

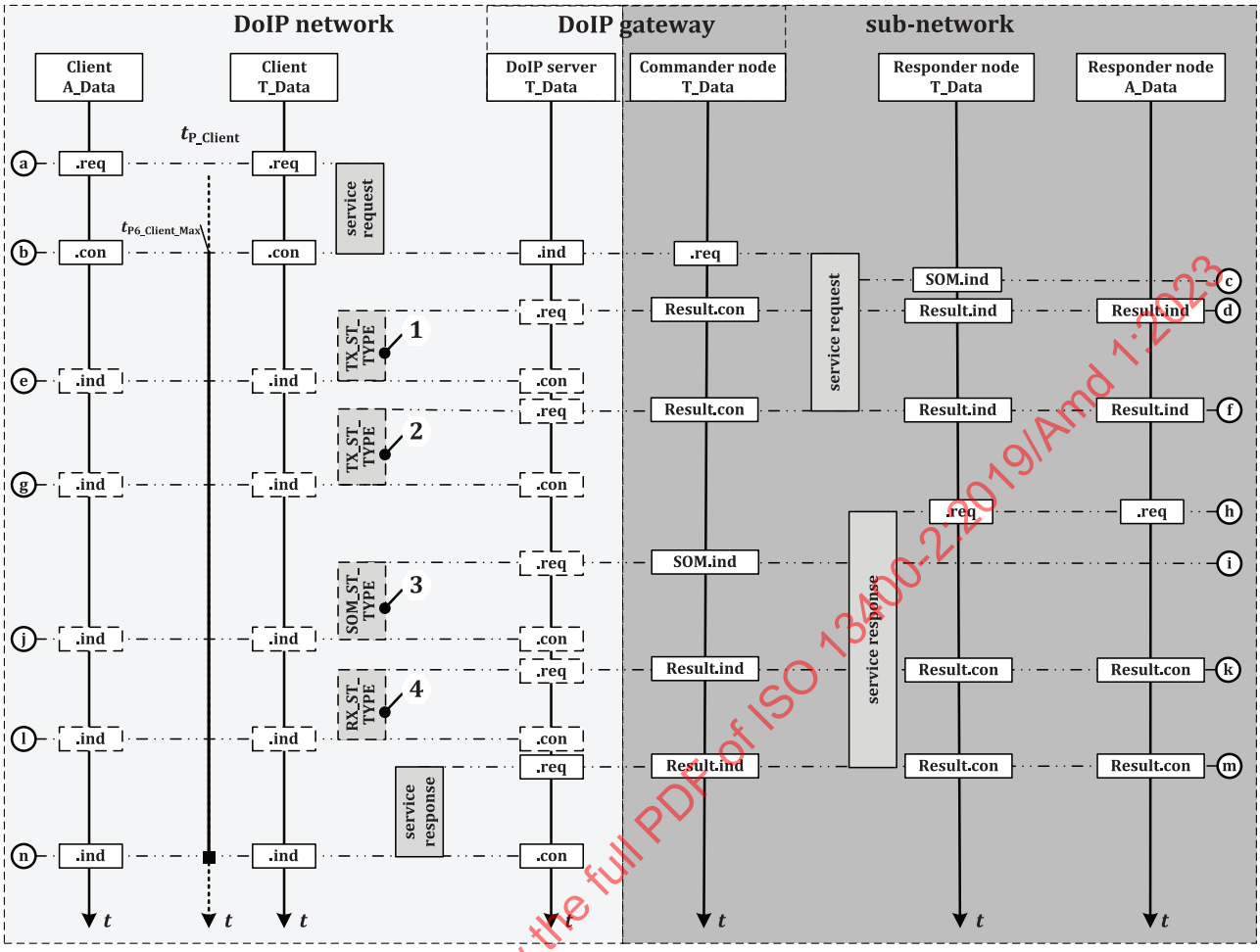
Former Figure 26 is renumbered to Figure 27.

Former Figure 27 is renumbered to Figure 28.

Former Figure 28 is renumbered to Figure 29.

All references to Figures 22 to 28 are renumbered accordingly.

Figure 22 shows the DoIP transport protocol status message.



Key

1 optional DoIP gateway server transport protocol status message `TX_ST_TYPE` to indicate to the DoIP client `T_Data` interface that the DoIP gateway server node has requested a failed `Result` caused by the sub-network transmission of the service request message.

2 optional DoIP gateway server transport protocol status message `TX_ST_TYPE` to indicate to the DoIP client `T_Data` interface that the sub-network commander node has successfully transmitted the service request message on the sub-network.

3 optional DoIP gateway server transport protocol StartOfMessage transmission status message `SOM_ST_TYPE` to indicate to the DoIP client `T_Data` interface that the commander node has received an `SOM.ind` StartOfMessage indication of a service response message.

4 optional DoIP gateway server transport protocol status message `RX_ST_TYPE` to indicate to the DoIP client `T_Data` interface that the DoIP gateway server node has requested a failed `Result` caused by the sub-network reception of the service response message.

a DoIP client `A_Data.req`: the application of the DoIP client starts the transmission of the service request message by issuing a `T_Data.req` to its transport layer.

b DoIP client `T_Data.con`: the completion of the service request message is indicated via a `T_Data.con` to the DoIP client application layer.

The DoIP gateway server initiates a `T_Data.ind` and the sub-network commander node initiates a `T_Data.req` to start the transmission of the service request message.

c The `T_Data` interface of the sub-network responder node initiates a `T_DataSOM.ind` based on the status of the service request message transmission.

d The sub-network responder node detects a reception error of the segmented message transmission by the sub-network commander node and initiates a `T_Data.ind` and an `A_Data.ind` to its application layer including the reception error result.