
**Road vehicles — Unified diagnostic
services (UDS) —**

**Part 4:
Unified diagnostic services on FlexRay
implementation (UDSonFR)**

Véhicules routiers — Services de diagnostic unifiés (SDU) —

Partie 4: SDU sur l'implémentation FlexRay (SDU sur FR)





COPYRIGHT PROTECTED DOCUMENT

© ISO 2012

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms, definitions and abbreviated terms	1
3.1 Terms and definitions	1
3.2 Abbreviated terms	1
4 Conventions	2
5 Document overview	2
6 Unified diagnostic services implementation on FlexRay	4
6.1 General	4
6.2 UDS on FlexRay services overview	4
6.3 CommunicationControl (0x28) service	5
6.4 ResponseOnEvent (0x86) service	5
6.5 LinkControl (0x87) service	7
6.6 ReadDataByPeriodicIdentifier (0x2A) service	8
7 Application layer requirements	14
7.1 Application layer services	14
7.2 Application layer protocol	14
7.3 Application layer timing	14
8 Presentation layer requirements	14
9 Session layer requirements	14
10 Transport/Network layer interface adaptation	14
10.1 General information	14
10.2 DoFR Transport/Network layer interface adaptation	14
11 Data Link layer diagnostic implementation requirements	15
Bibliography	16

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 14229-4 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

ISO 14229 consists of the following parts, under the general title *Road vehicles — Unified diagnostic services (UDS)*:

- *Part 1: Specification and requirements*
- *Part 2: Session layer services*
- *Part 3: Unified diagnostic services on CAN implementation (UDSonCAN)*
- *Part 4: Unified diagnostic services on FlexRay implementation (UDSonFR)*
- *Part 5: Unified diagnostic services on Internet Protocol implementation (UDSonIP)*
- *Part 6: Unified diagnostic services on K-Line implementation (UDSonK-Line)*

The following parts are under preparation / are planned:

- *Part 7: Unified diagnostic services on Local Interconnect Network implementation (UDSonLIN)*

Introduction

This part of ISO 14229 has been established in order to enable the implementation of unified diagnostic services, as specified in ISO 14229-4, on FlexRay (UDSonFR).

To achieve this, it is based on the Open Systems Interconnection (OSI) Basic Reference Model specified in ISO/IEC 7498-1 and ISO/IEC 10731, which structures communication systems into seven layers. When mapped on this model, the services specified by ISO 14229 are divided into:

- Application layer (layer 7):
 - Vehicle manufacturer enhanced diagnostics: ISO 14229-1, ISO 14229-4,
 - Legislated OBD: ISO 15031-5,
 - Legislated WWH-OBD: ISO 14229-1 / ISO 27145-3;
- Presentation layer (layer 6):
 - Vehicle manufacturer enhanced diagnostics: vehicle manufacturer specific,
 - Legislated OBD: SAE J1930-DA, SAE J1979-DA, SAE J2012-DA,
 - Legislated WWH-OBD: ISO 27145-2 with reference to SAE J1930-DA, SAE J1939, Companion Spreadsheet (SPNs), SAE J1939-73:2010, Appendix A (FMIs), SAE J1979-DA and SAE J2012-DA;
- Session layer services (layer 5):
 - Vehicle manufacturer enhanced diagnostics: ISO 14229-2,
 - Legislated OBD: ISO 14229-2,
 - Legislated WWH-OBD: ISO 14229-2;
- Transport layer services (layer 4):
 - Vehicle manufacturer enhanced diagnostics: ISO 10681-2,
 - Legislated OBD: ISO 10681-2, ISO 15765-4
 - Legislated WWH-OBD: ISO 27145-4;
- Network layer services (layer 3):
 - Vehicle manufacturer enhanced diagnostics: ISO 10681-2,
 - Legislated OBD: ISO 15765-2, ISO 15765-4
 - Legislated WWH-OBD: ISO 27145-4;
- Data link layer (layer 2):
 - Vehicle manufacturer enhanced diagnostics: ISO 17458-2,
 - Legislated OBD: ISO 11898-1, ISO 11898-2, ISO 15765-4,
 - Legislated WWH-OBD: ISO 27145-4;
- Physical layer (layer 3):
 - Vehicle manufacturer enhanced diagnostics: ISO 17458-4,
 - Legislated OBD: ISO 11898-1, ISO 11898-2, ISO 15765-4,

— Legislated WWH-OBD: ISO 27145-4;

in accordance with Table 1.

Table 1 — DoFR enhanced diagnostics, legislated OBD and WWH-OBD specification reference applicable to the OSI layers

Applicability	OSI 7 layers	Vehicle manufacturer enhanced diagnostics	Legislated OBD (On-Board Diagnostics)	Legislated WWH-OBD (On-Board Diagnostics)		
Seven layer according to ISO/IEC 7498-1 and ISO/IEC 10731	Application (layer 7)	ISO 14229-1/ISO 14229-4	ISO 15031-5	ISO 14229-1/ISO 27145-3		
	Presentation (layer 6)	Vehicle manufacturer specific	SAE J1930-DA, SAE J1979-DA, SAE J2012-DA	ISO 27145-2 SAE J1930-DA, SAE J1939 Companion Spreadsheet (SPNs), SAE J1939-73:2010, Appendix A (FMIs), SAE J1979-DA, SAE J2012-DA		
	Session (layer 5)	ISO 14229-2				
	Transport (layer 4)	ISO 10681-2	ISO 15765-2, ISO 15765-4	ISO 15765-2, ISO 15765-4	ISO 27145-4	ISO 13400-2
	Network (layer 3)					
	Data link (layer 2)	ISO 17458-2	ISO 11898-1, ISO 11898-2, ISO 15765-4	ISO 11898-1, ISO 11898-2, ISO 15765-4		ISO 13400-3, IEEE 802.3
	Physical (layer 1)	ISO 17458-4				

Road vehicles — Unified diagnostic services (UDS) —

Part 4:

Unified diagnostic services on FlexRay implementation (UDSonFR)

1 Scope

This part of ISO 14229 specifies the implementation of a common set of unified diagnostic services (UDS) on FlexRay networks (FR) in road vehicles (UDSonFR).

UDSonFR references ISO 14229-1 and ISO 14229-2 and specifies implementation requirements of the diagnostic services to be used for diagnostic communication over FlexRay.

NOTE UDSonFR does not specify any requirements of the in-vehicle FlexRay architecture.

This part of ISO 14229 does not include any redundant information of the documents as listed in the introduction. It focuses on

- additional requirements specific to the implementation of UDS on the FlexRay network, and
- specific restrictions in the implementation of UDS on the FlexRay network.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 14229-1, *Road vehicles — Unified diagnostic services (UDS) — Part 1: Specification and requirements*

ISO 14229-2, *Road vehicles — Unified diagnostic services (UDS) — Part 2: Session layer services*

ISO 10681-2, *Road vehicles — Communication on FlexRay — Part 2: Communication layer services*

ISO 17458-2, *Road vehicles — FlexRay Communication Systems — Protocol specification*

ISO 17458-4, *FlexRay Communication Systems — Electrical physical layer specification*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14229-1, ISO 14229-2, and ISO 10681-2 apply.

3.2 Abbreviated terms

CF consecutive frame

DoFR diagnostic communication over FlexRay

FC	flow control
FR	FlexRay
ISO	International Standardization Organization
LF	last frame
OSI	Open System Interconnection
Rx	reception
SA	source address
SID	service identifier
SM	subnet mask
SOM	start of message
STF	start frame
STRT	serviceToRespondTo
TA	target address
UDS	unified diagnostic services
Tx	transmission
UDSonFR	Unified Diagnostic Services (UDS) on FlexRay

4 Conventions

This part of ISO 14229 is based on the conventions discussed in the OSI Service Conventions (ISO/IEC 10731:1994) as they apply for diagnostic services.

5 Document overview

Figure 1 illustrates the document references from ISO 14229-1, ISO 14229-2 and ISO 10681-1 and ISO 10681-2. ISO 14229-4 uses only a subset of the diagnostic services defined in ISO 14229-1 (see Table 2).

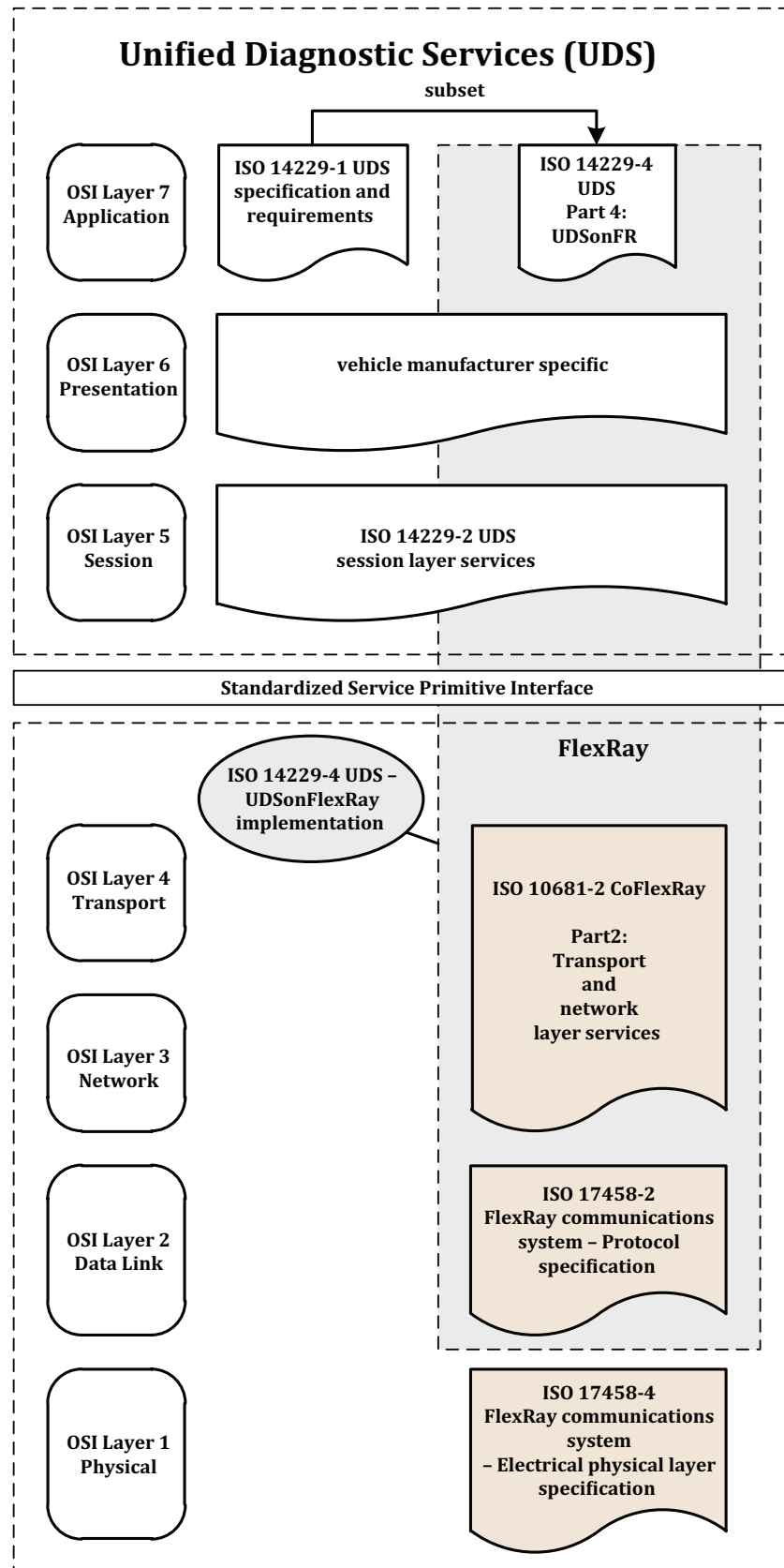


Figure 1 — ISO 14229-4, UDSONFR document reference according to OSI model

6 Unified diagnostic services implementation on FlexRay

6.1 General

This clause defines how the diagnostic services as defined in ISO 14229-1 apply to FlexRay. For each service, the applicable sub-function and data parameters are defined.

NOTE The sub-function parameter definitions take into account that the most significant bit is used for the suppressPosRspMsgIndicationBit parameter as defined in ISO 14229-1.

6.2 UDS on FlexRay services overview

The purpose of Table 2 is to reference all ISO 14229-1 and ISO 14229-2 services as they are applicable for an implementation in ISO 14229-4, UDSONFR. Table 2 contains the sum of all applicable services. Certain applications using this part of ISO 14229 to implement UDSONFR may restrict the number of useable services and may categorize them in certain application areas/diagnostic sessions (default session, programming session, etc.).

Services in Table 2 that are marked “No FlexRay specific requirements” shall be implemented as defined in ISO 14229-1 and ISO 14229-2 with no additional restrictions. Services that are marked “FlexRay specific requirements” shall be implemented as defined by the subclause listed in the Table 2 entry.

Table 2 — Overview of applicable ISO 14229-1 unified diagnostic services and data ranges

Diagnostic service name (ISO 14229-1)	Comment	Reference in this document
Diagnostic and Communication Management Functional Unit		
DiagnosticSessionControl	No FlexRay specific requirements	—
ECUReset	No FlexRay specific requirements	—
SecurityAccess	No FlexRay specific requirements	—
CommunicationControl	FlexRay specific requirements	see 6.3
TesterPresent	No FlexRay specific requirements	—
SecuredDataTransmission	No FlexRay specific requirements	—
ControlDTC-Setting	No FlexRay specific requirements	—
ResponseOnEvent	FlexRay specific requirements	see 6.4
LinkControl	FlexRay specific requirements	see 6.5
Data Transmission Functional Unit		
ReadDataByIdentifier	No FlexRay specific requirements	—
ReadMemoryByAddress	No FlexRay specific requirements	—
ReadScalingDataByIdentifier	No FlexRay specific requirements	—
ReadDataByPeriodicIdentifier	FlexRay specific requirements	see 6.6
DynamicallyDefineDataIdentifier	No FlexRay specific requirements	—
WriteDataByIdentifier	No FlexRay specific requirements	—
WriteMemoryBy-Address	No FlexRay specific requirements	—
ReadDTCInformation	No FlexRay specific requirements	—
ClearDiagnosticInformation	No FlexRay specific requirements	—
Input/Output Control Functional Unit		
InputOutputControlByIdentifier	No FlexRay specific requirements	—

Table 2 (continued)

Diagnostic service name (ISO 14229-1)	Comment	Reference in this document
Remote Activation Of Routine Functional Unit		
RoutineControl	No FlexRay specific requirements	—
Upload/Download Functional Unit		
Request-Download	No FlexRay specific requirements	—
RequestUpload	No FlexRay specific requirements	—
TransferData	No FlexRay specific requirements	—
RequestTransferExit	No FlexRay specific requirements	—
RequestFileTransfer	No FlexRay specific requirements	—

6.3 CommunicationControl (0x28) service

The following requirements as stated in Table 3 shall apply for this service when implemented on FlexRay.

Table 3 — Service 0x28 sub-function implementation definition on FlexRay

Hex (bit 6-0)	Description	Cvt	Mnemonic
00	enableRxAndTx — FlexRay communication in the static segment is switched on; — FlexRay communication in the dynamic segment (if applicable) is switched on;	M	ERXTX
01	enableRxAndDisableTx Enables the Rx - communication in the static and dynamic segment; Disables the Tx - communication in the static and the dynamic segment ^a : — In the static segment only null frames are sent in the individual slots. — In the dynamic segment (if applicable) communication is switched off (results in minislots only).	M	ERXDTX
02	disableRxAndEnableTx — Disables the Rx - communication in the static and dynamic segment; — Enables the Tx - communication in the static and the dynamic segment;	M	DRXETX
03	disableRxAndTx Disables the communication (Rx and Tx) in the static and the dynamic segment. Impacts on Tx and Rx for the static and dynamic segment are the same as described for sub-function 0x01 and 0x02.	M	DRXTX
^a It needs to be ensured that basic network functionality (e.g. synchronization) is not negatively influenced by disabling Tx communication.			

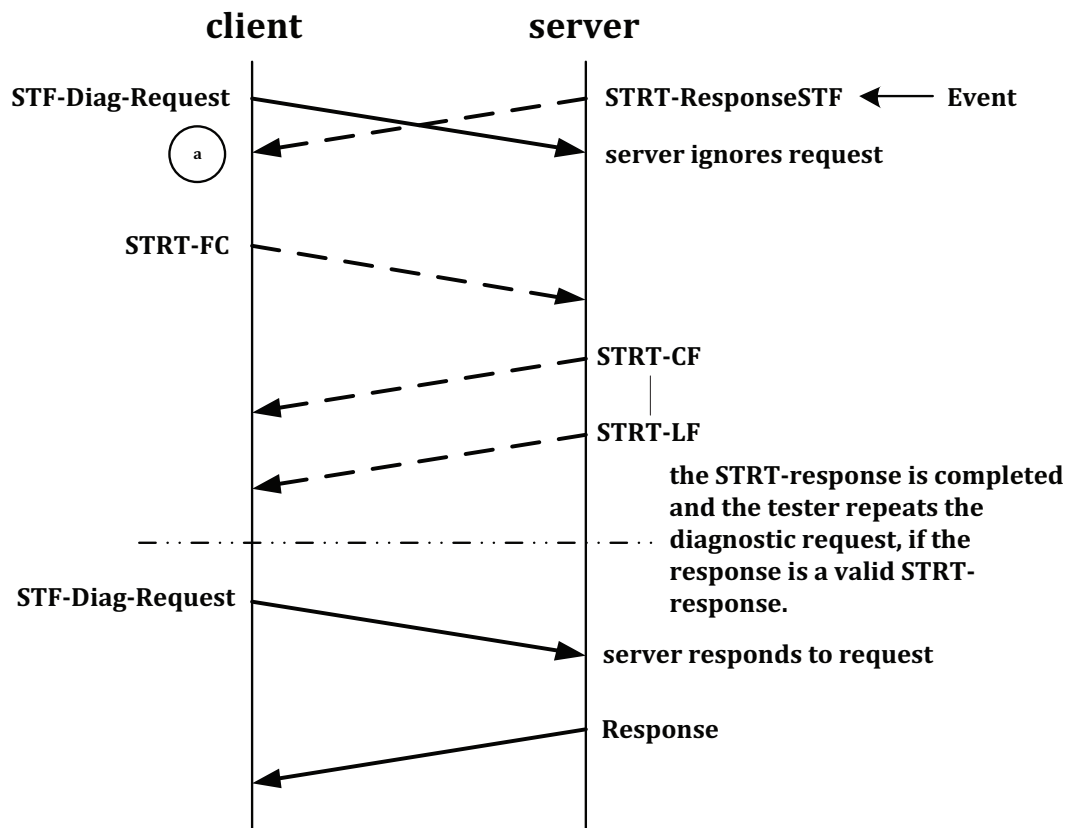
6.4 ResponseOnEvent (0x86) service

In addition to the generic implementation requirements stated in ISO 14229-1 the following additional FlexRay specific implementation requirements shall apply:

While the ResponseOnEvent service is active, the server shall be able to process concurrent diagnostic request and response messages accordingly. This should be accomplished with a different serviceToRespondToFlexRay source address. If the same diagnostic FlexRay source and target

addresses are used for diagnostic communication and the serviceToRespondTo-responses, the following restrictions shall apply.

- a) The server shall ignore an incoming diagnostic request after an event has occurred and the serviceToRespondTo-response is in progress, until the serviceToRespondTo-response is completed.
- b) When the client receives any response after sending a diagnostic request, the response shall be classified according to the possible serviceToRespondTo-responses and the expected diagnostic responses to the previously sent request.
 - 1) If the response is a serviceToRespondTo-response (one of the possible responses set up with ResponseOnEvent-service), the client shall repeat the request after the serviceToRespondTo-response has been received completely.
 - 2) If the response is ambiguous (i.e. the response could originate from the serviceToRespondTo initiated by an event or from the response to a diagnostic request), the client shall present the response both as a serviceToRespondTo-response and as the response to the diagnostic request. The client shall not repeat the request with the exception of NegativeResponseCode busyRepeatRequest (0x21). (See the negative response code definitions in ISO 14229-1.)



^a In the example given it is assumed, that the STRT-Response STF caused by the event is sent in the same FR cycle as the diagnostic request from the client.

Figure 2 — Concurrent request when the event occurs

- c) When the specified event is detected, the server shall respond immediately with the appropriate serviceToRespondTo-response message. The immediate serviceToRespondTo-response message shall not disrupt any other diagnostic request or response transmission already in progress (i.e. the serviceToRespondTo-response shall be delayed until the current message transmission has been completed — see Figure 3).

NOTE In case the event occurs while the diagnostic request has not been indicated as being in progress to the upper layers of the server, it would transmit the serviceToRespondTo-response and ignores the diagnostic request (see Figure 2).

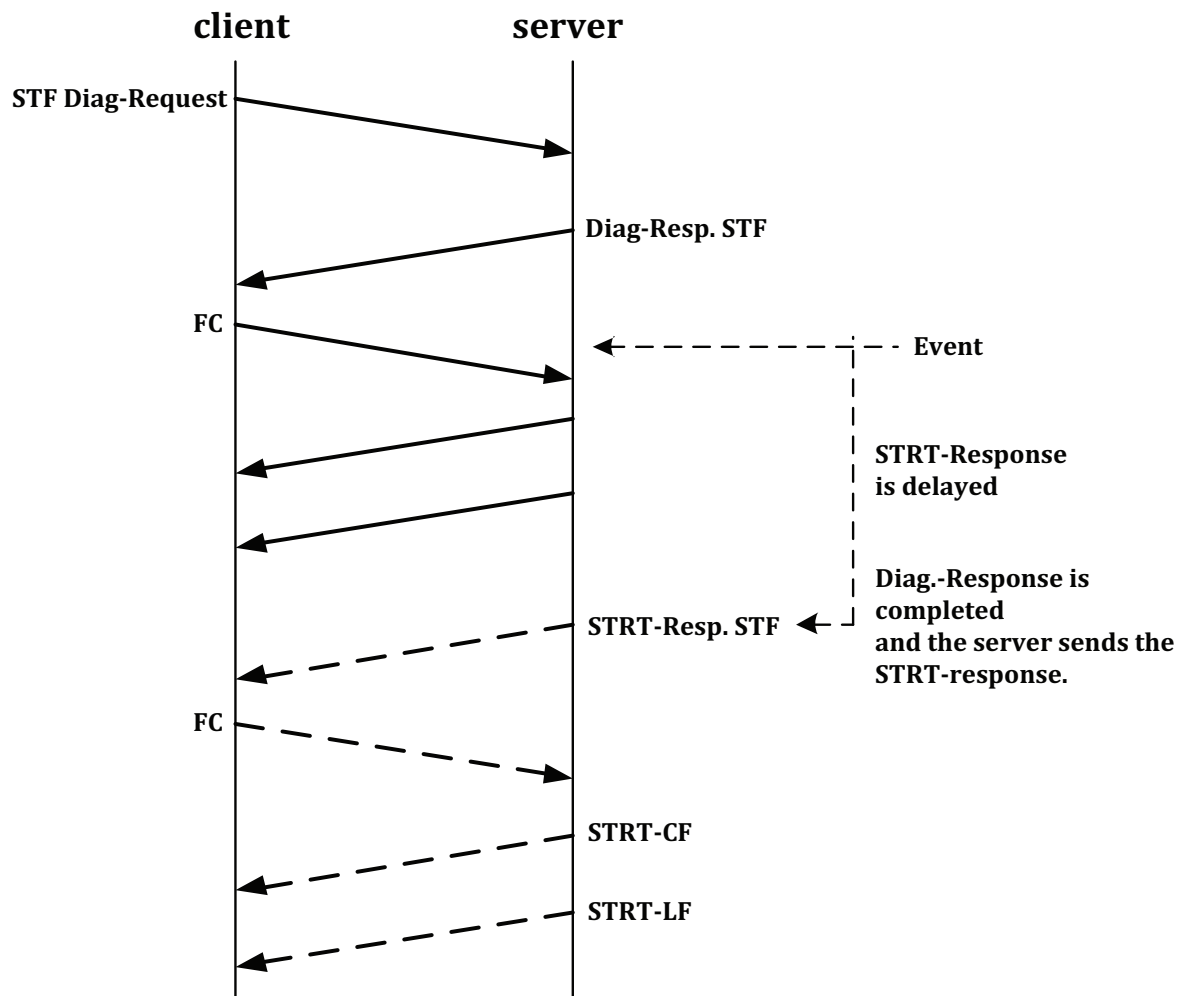


Figure 3 — Event occurrence during a message in progress

6.5 LinkControl (0x87) service

LinkControl is utilized in FlexRay to adapt data link relevant parameters such, that diagnostic communication bandwidth is maximized (e.g. programming event). This results in an adaptation of the FlexRay cycle design (e.g. enhance dynamic segment, optimize frame length of diagnostic messages, etc.). However, the detailed implementation is vehicle manufacturer specific and shall be described in an individual implementation specification.

The following requirements shall apply for this service when implemented on FlexRay.

The communication strategy shall follow the requirements as stated in ISO 14229-1:

- **Step #1:** Shall follow the definition stated in ISO 14229-1.
- **Step #2:** The client requests the mode transition to adapt the FlexRay cycle design as specified in the individual implementation specification. This step shall only be requested if step #1 has been performed successfully. In case of functional communication it is recommended that there shall not be any response from a server when the mode transition is performed (suppressPosRspMsgIndicationBit = TRUE), because one server might already have been transitioned to the new mode while others are still in progress.

The individual FlexRay implementation shall follow the requirements as stated in Table 4.

Table 4 — Request message sub-function Parameter Definition

Hex (bit 6-0)	Description	Cvt	Mnemonic
01	verifyModeTransitionWithFixedParameter This parameter is used to verify if a transition with a pre-defined FlexRay schedule design, which is specified by the linkControlModelIdentifier data parameter can be performed.	M	ERXTX
02	verifyModeTransitionWithSpecificParameter Not applicable for FlexRay	M	ERXDTX
03	transitionMode This sub-function parameter requests the server(s) to transition the FlexRay to the schedule design which was requested in the preceding verification message.	M	TM

6.6 ReadDataByPeriodicIdentifier (0x2A) service

6.6.1 Periodic transmission response message

The ReadDataByPeriodicIdentifier service allows the client to request the periodic transmission of data record values from the server identified by one or more periodicDataIdentifiers. For service 0x2A implementation on FlexRay, the periodic transmission response message is supported according to ISO 14229-1.

The usage of the periodic transmission response message should consider a single data format being supported for the whole vehicle which may consist of other data links than FlexRay. E.g. if CAN is part of the electrical vehicle architecture in addition to FlexRay, the total DID data length shall not exceed the length limitations of the CAN protocol to ensure a single data format.

Table 5 describes the requirements for periodic transmission response message.

Table 5 — Periodic transmission — Requirements for response message mapping

Message type	Client request requirements	Server response requirements	Further server restrictions
Periodic transmission response message uses a different FlexRay source address for periodic message transmissions	No restrictions	Only single FlexRay frame responses for periodic transmission Multi-frame responses (non-periodic-transmission) are possible in parallel while periodic responses are in progress	The request for periodic transmission is processed as a regular diagnostic request and the response is sent via the communication layer (as a FlexRay message with service identifier 0x6A)
			On receiving the C_Data.confirm that indicates the completion of the transmission of the positive response, the application starts an independent scheduler, which handles the periodic transmission.
			The scheduler in the server processes the periodic transmission as a single FlexRay frame response message in a by-pass to the transport layer
			There is neither a protocol control information (PCI) nor a service identifier (SId) included in the response message. Only the periodic identifier and corresponding data are included.

6.6.2 Periodic transmission response message handling

6.6.2.1 General

Due to the fact, that the periodic transmission response message neither supports protocol control information nor the service identifier information (transport layer by-pass), the following service primitives need to be taken into account. The service primitives as defined below make use of the individual parameters as specified in ISO 10681-2:

6.6.2.2 C_UUData.request

The service primitive requests periodic transmission of < MessageData > with < Length > number of bytes from the sender to the receiver peer entities identified by the address information in C_SA and C_TA. Each time the C_UUData.request service is called, the communication layer shall signal the completion (or failure) of the message transmission to the service user by means of the issuing of a C_UUData.confirm service call.

```
C_UUData.request      (
                        C_SA,
                        C_TA,
                        <Length>,
                        <MessageData>
                        )
```

6.6.2.3 C_UUData.confirm

The C_UUData.confirm service is issued by the communication layer. The service primitive confirms the completion of a C_UUData.request service identified by the address information in C_SA and C_TA. The parameter < C_Result > provides the status of the service request (referring < C_Result > values defined in ISO 10681-2).

```
C_UUData.confirm      (
                        C_SA,
                        C_TA,
                        <C_Result>
                        )
```

NOTE Not all result values as defined in ISO 10681-2 apply for the periodic transmission response message.

6.6.2.4 C_UUData.indication

The C_UUData.indication service is issued by the communication layer. The service primitive delivers < MessageData > with < Length > bytes received from a peer protocol entity identified by the address information in C_SA and C_TA to the upper layer (see definition in ISO 10681-2).

The parameters < MessageData > and < Length > are only valid when the service primitive is indicated. In case of a reception error no indication will be generated. Therefore a < C_Result > parameter is not needed.

```
C_UUData.indication    (
                        C_SA,
                        C_TA,
                        <Length>,
                        <MessageData>
                        )
```

6.6.2.5 FlexRay frame format

6.6.2.5.1 General

Since the periodic transmission response message neither supports PCI information nor service identification information the protocol data unit format (PDU) differs to what is defined in ISO 10681-2. However the FlexRay periodic transmission PDU format also consists of three fields, as given in Table 6.

Table 6 — Periodic transmission PDU format

Address information	Length information	Data field
C_AI	FPL	C_Data <MessageData>

6.6.2.5.2 Address information

The C_AI is used to identify the communicating peer entities for the periodic message PDUs. The C_AI information received, which includes C_SA and C_TA, shall be copied and included into the periodic transmission PDU. Each periodic message uses a different source address (C_SA) as used for any other diagnostic response message.

6.6.2.5.3 Length Information

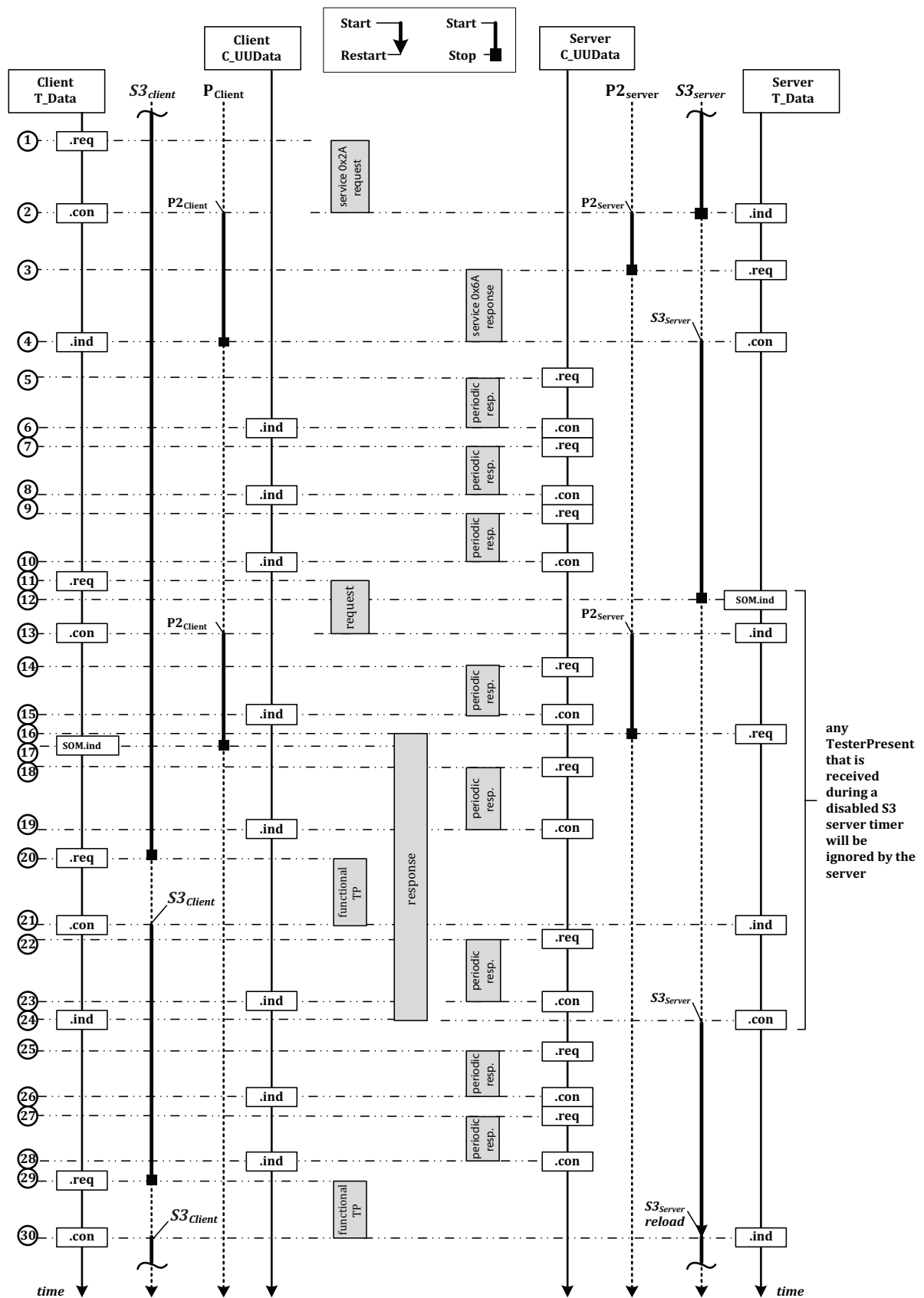
A frame payload length (FPL definition see ISO 10681-2 is required to identify the data range of valid payload information. This information is even needed in case periodic messages are gated from/to FlexRay to/from any other data link (e.g. CAN - > FR).

6.6.2.5.4 Data Field

The < MessageData > field contains periodic data information defined with a periodicDataIdentifier (PDID) and its corresponding data.

6.6.3 Periodic transmission message flow

Figure 4 graphically depicts periodic transmission response messages server handling as specified above. As already stated in 6.6.2, the figure shows that the periodically transmitted response messages do not have any influence on the S3_{Server} timer of the server. For the figure it is assumed that a non-defaultSession has been activated prior to the configuration of the periodic scheduler (the ReadDataByPeriodicIdentifier service requires a non-defaultSession in order to be executed).



Key

- 1 **Client T_Data.req:** The diagnostic application of the client starts the transmission of the ReadDataByPeriodicIdentifier (0x2A) request message by issuing a T_Data.req to its communication layer. The communication layer transmits the ReadDataByPeriodicIdentifier (0x2A) request message to the server. The request message can either be a segmented or unsegmented message (depends on the number of periodicDataIdentifier contained in the request message and the supported FlexRay frame length). For the example given, it is assumed that the request message fits into a single start frame

- 2 **Client T_Data.con:** The completion of the request message is indicated in the client via T_Data.con. Now the response timing as described in ISO 14229-2 applies

Server T_Data.ind: The completion of the request message is indicated in the server via the T_Data.ind. Now the response timing as described in ISO 14229-2 applies. Furthermore, the server stops its S3_{Server} timer

- 3 **Server T_Data.req:** It is assumed that the client requires a response from the server. The server shall transmit the ReadDataByPeriodicIdentifier positive response message to indicate that the request has been processed and that the transmission of the periodic messages will start afterwards

- 4 **Server T_Data.con:** The completion of the transmission of the ReadDataByPeriodicIdentifier response message is indicated in the server via T_Data.con. Now the server restarts its S3_{Server} timer, which keeps the activated non-default session active as long as it does not time out

Client T_Data.ind: The reception of the response message is indicated in the client

- 5 **Server C_UUData.req:** The server starts to transmit the periodic response messages (single FlexRay frame messages). Each periodic message which neither includes any PCI information nor service identification, uses a different source address as used for any other response message. Therefore, the server issues a C_UUData.req each time a periodic message is transmitted independent of any other service currently processed by the server. This means that the transmission of the periodic response messages continues even when the server is in the process of handling another diagnostic service request. The transmission of the periodic response messages has no influence on the S3_{Server} timer

- 6 **Server C_UUData.con:** The completion of the transmission of the periodic response message is indicated in the server

Client C_UUData.ind: The completion of the reception of the periodic response message is indicated in the client

- 7 See (5)

- 8 See (6)

- 9 See (5)

- 10 See (6)

- 11 **Client T_Data.req:** The diagnostic application of the client starts the transmission of the next request message by issuing a T_Data.req to its communication layer. The communication layer transmits the request message to the server. The request message can either be an unsegmented or segmented message. For the example given, it is assumed that the request message is a multi-frame message

- 12 **Server T_Data_SOM.ind:** The start of a request message is indicated in the server via T_Data_SOM.ind while a periodic scheduler is active. The server does not stop the periodic scheduler for the duration of processing the received request message. This means that the server transmits further periodic messages for the duration of processing the diagnostic service. The client shall be aware of receiving these periodic response messages. Furthermore, any time the server is in the process of handling any diagnostic service it stops its S3_{Server} timer

- 13 **Client T_Data.con:** The completion of the request message is indicated in the client via T_Data.con. Now the response timing as described in ISO 14229-2 applies

- Server T_Data.ind:** The completion of the multi-frame request message is indicated in the server via the T_Data.ind. Now the response timing as described in ISO 14229-2 applies
- 14 See (5)
- 15 See (6)
- 16 **Server T_Data.req:** For the figure given, it is assumed that the client requires a response from the server. The server shall transmit the positive (or negative) response message via issuing T_Data.req to its communication layer. For the example, it is assumed that the response is a multi-frame message. While the multi-frame response message is transmitted by the communication layer, the periodic scheduler continues to transmit the periodic response messages
- 17 **Client T_Data_SOM.ind:** The start of the response message is indicated in the client
- 18 See (5)
- 19 See (6)
- 20 **Client T_Data.req:** When the S3_{Client} timer times out in the client, then the client transmits a functionally addressed TesterPresent (0x3E) request message to reset the S3_{Server} timer in the server
- 21 **Server T_Data.ind:** The server is in the process of transmitting the multi-frame response of the previous request. Therefore, the server shall not act on the received TesterPresent (0x3E) request message, because its S3_{Server} timer is not yet re-activated
- Client T_Data.con:** The reception of the TesterPresent (0x3E) request message is indicated in the server
- 22 See (5)
- 23 See (6)
- 24 **Server T_Data.con:** When the diagnostic service is completely processed, then the server restarts its S3_{Server} timer. This means that any diagnostic service, including TesterPresent (0x3E), resets the S3_{Server} timer. A diagnostic service is meant to be in progress any time between the start of the reception of the request message (T_Data_SOM.ind or T_Data.ind receive) and the completion of the transmission of the response message, where a response message is required, or the completion of any action that is caused by the request, where no response message is required (point in time reached that would cause the start of the response message). This includes negative response messages including response code 0x78
- 25 See (5)
- 26 See (6)
- 27 See (5)
- 28 See (6)
- 29 **Client T_Data.req:** Once the S3_{Client} timer is started in the client (non-defaultSession active), this causes the transmission of a functionally addressed TesterPresent (0x3E) request message, which does not require a response message, each time the S3_{Client} timer times out
- 30 **Client T_Data.con:** Upon the indication of the completed transmission of the TesterPresent (0x3E) request message via T_Data.con of its communication layer, the client once again starts its S3_{Client} timer. This means that the functionally addressed TesterPresent (0x3E) request message is sent on a periodic basis every time S3_{Client} times out

Figure 4 — Periodic transmission response message handling

7 Application layer requirements

7.1 Application layer services

This part of ISO 14229 uses the application layer services as defined in ISO 14229-1 for client-server based systems to perform functions such as test, inspection, monitoring, diagnosis or programming of on-board vehicle servers.

7.2 Application layer protocol

This part of ISO 14229 uses the application layer protocol as defined in ISO 14229-1.

7.3 Application layer timing

The application layer timing parameter values shall be in accordance with the definitions in ISO 14229-2.

8 Presentation layer requirements

The presentation layer requirements are the responsibility of the vehicle manufacturer.

9 Session layer requirements

The session layer requirements are specified in ISO 14229-2.

10 Transport/Network layer interface adaptation

10.1 General information

This part of ISO 14229 makes use of the network layer services defined in ISO 14229-2 for the transmission and reception of diagnostic messages. This subclause defines the mapping of the data link independent transport/network layer protocol data units (T_PDU) onto the FlexRay data link specific network layer protocol data units (C_PDU).

NOTE The transport/network layer services are used to perform the application layer and diagnostic session management timing.

For a diagnostic message communication this part of ISO 14229 only utilizes the ISO 10681-2 technical feature of transmitting messages with known data length.

10.2 DoFR Transport/Network layer interface adaptation

10.2.1 Mapping of data link independent service primitives onto FlexRay data link dependent service primitives

Table 7 specifies the mapping interface between the ISO 10681-2, DoFR Part 2: Communication layer services and the session layer services defined in ISO 14229-2 for the transmission and reception of diagnostic messages.

Table 7 — Mapping of T_PDU service primitives onto C_PDU service primitives

Session to transport/network layer service primitives (data link independent according to ISO 14229-2)	DoFR network layer service primitives (data link dependent according to ISO 10681-2)
T_Data.indication	C_Data.indication
T_DataSOM.indication	C_Data_STF.indication
T_Data.confirm	C_Data.confirm
T_Data.request	C_Data.request

10.2.2 Mapping of T_PDU onto C_PDU for message transmission

The parameters of the application layer protocol data unit defined to request the transmission of a diagnostic service request/response are mapped in accordance with Table 8 onto the parameters of the communication layer protocol data unit for the transmission of a message in the client/server.

Table 8 — Mapping of T_PDU parameter onto C_PDU parameter

T_PDU parameter (data link independent according to ISO 14229-2)	C_PDU parameter (FlexRay data link dependent according to ISO 10681-2)
T_Mtype	N/A ^a
T_SA	C_SA
T_TA	C_TA
T_TAtype	C_TAtype
T_AE	N/A ^b
T_Data []	<MessageData>
T_Length	<Length>
N/A	<ActualLength> ^c
T_Result	<C_Result>
^a Remote diagnostic feature is not supported by the FlexRay communication layer. ^b Extended addressing is not supported by the FlexRay communication layer. ^c Set to zero in the FlexRay communication layer.	

The network layer confirmation of the successful transmission of the message (C_Data.con) is forwarded to the application, because it is needed in the application for starting those actions, which shall be executed immediately after the transmission of the request/response message (ECUReset, BaudrateChange, etc.).

The address mapping between the network layer and the OSI higher layers is not necessarily an exact copy of the address values as encoded on the data link layer and therefore depends on the implementation concept.

11 Data Link layer diagnostic implementation requirements

The FlexRay data link implementation shall follow the requirements stated in ISO 10681-2 and ISO 17458-2.

Bibliography

- [1] ISO/IEC 7498-1, *Information processing systems — Open systems interconnection — Basic reference model*
- [2] ISO 10681-1, *Road vehicles — Communication on FlexRay — Part 1: General information and use case definition*
- [3] ISO/IEC 10731:1994, *Information technology — Open Systems Interconnection — Basic Reference Model — Conventions for the definition of OSI services*
- [4] ISO 11898-1, *Road vehicles — Controller area network (CAN) — Part 1: Data link layer and physical signalling*
- [5] ISO 11898-2, *Road vehicles — Controller area network (CAN) — Part 2: High-speed medium access unit*
- [6] ISO 13400 (all parts), *Road vehicles — Communication between test equipment and vehicles over Internet Protocol*
- [7] ISO 15031-5, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 5: Emissions-related diagnostic services*
- [8] ISO 15765-2, *Road vehicles — Diagnostic communication over Controller Area Network (DoCAN) — Part 2: Transport protocol and network layer services*
- [9] ISO 15765-4, *Road vehicles — Diagnostic communication over Controller Area Network (DoCAN) — Part 4: Requirements for emissions-related systems*
- [10] ISO 27145-4, *Road vehicles — Implementation of World-Wide Harmonized On-Board Diagnostics (WWH-OBd) communication requirements — Part 4: Connection between vehicle and test equipment*
- [11] SAE J1930-DA, *Digital Annex of Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms Web Tool Spreadsheet*
- [12] SAE J1939, *Companion Spreadsheet (CS1939)*
- [13] SAE J1939-73:2010, *Recommended Practice for a Serial Control and Communication Vehicle Network — Application layer — Diagnostics*
- [14] SAE J1979-DA, *Digital Annex of E/E Diagnostic Test Modes*
- [15] SAE J2012-DA, *Digital Annex of Diagnostic Trouble Code Definitions and Failure Type Byte Definitions*

