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Road vehicles — Communication on FlexRay —

Part 2: Communication layer services

Véhicules routiers — Communication par FlexRay —

Partie 2: Services de la couche de communication

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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 10681-2 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

ISO 10681 consists of the following parts, under the general title *Road vehicles — Communication on FlexRay*:

— *Part 1: General information and use case definition*

— *Part 2: Communication layer services*

Introduction

This part of ISO 10681 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 (see example in Table 1). When mapped on this model, this part of ISO 10681 incorporates the network layer (layer 3) and the transport layer (layer 4) services as communication layer services.

Table 1 — Example of enhanced diagnostic specifications according to the OSI layers

Applicability	OSI layers	Vehicle manufacturer enhanced diagnostics
Seven layers according to ISO/IEC 7498-1 and ISO/IEC 10731	Application layer	ISO 14229-1
	Presentation layer	N/A
	Session layer	ISO 14229-2
	Transport layer	ISO 10681-2
	Network layer	
	Data link layer	FlexRay Communications Systems Protocol Specification
	Physical layer	FlexRay Communications System Electrical Physical Layer Specification

Road vehicles — Communication on FlexRay —

Part 2:
Communication layer services

1 Scope

This part of ISO 10681 specifies the requirements for a communication protocol tailored to meet the requirements of FlexRay-based vehicle network systems as specified in the FlexRay Communications Systems Protocol Specification. As the communication protocol combines the network layer and transport layer functionality (OSI layers 3 and 4), this part of ISO 10681 does not explicitly distinguish between these layer services.

The technical features of this communication protocol are as follows:

— transmit messages with known data length;

— transmit messages with unknown but finite data length;

— additional acknowledgement with retry mechanism;

— routing data on the fly;

— support of dynamic frame length.

2 Normative references

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

ISO/IEC 7498-1, *Information technology — Open Systems Interconnection — Basic Reference Model: The Basic Model*

ISO 7498-2, *Information processing systems — Open Systems Interconnection — Basic Reference Model — Part 2: Security Architecture*

ISO/IEC 7498-3, *Information technology — Open Systems Interconnection — Basic Reference Model: Naming and addressing*

ISO/IEC 7498-4, *Information processing systems — Open Systems Interconnection — Basic Reference Model — Part 4: Management framework*

ISO/IEC 10731, *Information technology — Open Systems Interconnection — Basic Reference Model — Conventions for the definition of OSI services*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 7498-1, ISO 7498-2, ISO/IEC 7498-3 and ISO/IEC 7498-4 and the following apply.

3.1.1
communication layer
CL
layer that includes the network layer (layer 3) and the transport layer (layer 4)

3.1.2
protocol data unit
PDU
⟨layered system⟩ data unit that is specified in the protocol of a given layer

NOTE The protocol data unit contains user data of that layer and possible protocol control information. The protocol data unit of layer X is the service data unit of its lower layer (X – 1).

3.1.3
service data unit
SDU
⟨layered system⟩ set of data that is sent by a user of the service in a given layer

NOTE It is transmitted to a peer service user with no semantic change.

3.2 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

ABT	abort
ACK	acknowledge
BC	bandwidth control
BfS	buffer size
BP	byte position
C_AI	communication address information
C_Ar	communication layer timing parameter A receiver
C_As	communication layer timing parameter A sender
C_Br	communication layer timing parameter B receiver
C_Bs	communication layer timing parameter B sender
C_Cr	communication layer timing parameter C receiver
C_Cs	communication layer timing parameter C sender
C_CT	communication type
C_Data	communication layer data transfer service name
C_PCI	communication protocol control information
C_SA	communication source address
C_TA	communication target address

C_TAType	communication target address type
CF	consecutive frame
CL	communication layer
COMM	communication
CTS	continue to send
C_PDU	communication layer protocol data unit
C_SDU	communication layer service data unit
DLL	data link layer
ECU	electronic control unit
EOB	end of block
FC	flow control
FIFO	first in first out
FPL	frame payload length
FR	FlexRay
FS	flow status
Ind	indication
LF	last frame
L_PDU	data link layer protocol data unit
max	maximum
ML	message length
MNPC	maximum numbers of PDUs per cycle
N/A	not applicable
N_PDU	network protocol data unit
NUM	number
OVFLW	overflow
PDU	protocol data unit
pLatestTx	latest point of transmission
Req	request
RET	retry
RX	receive
SCexp	separation cycle exponent
SDU	service data unit
SN	sequence number
STF	start frame
STFA	start frame acknowledged
STFU	start frame unacknowledged

UNEXP	unexpected
UNUM	unsigned numeric
TX	transmission
WFT	wait frame transmission
WT	wait

3.3 Symbols

Σ	summation
$\neq$	not equal

4 Conventions

ISO 10681 is based on the conventions discussed in the OSI Services Conventions (ISO/IEC 10731:1994) as they apply for diagnostic services.

5 Communication layer overview

5.1 General

This clause describes the overall functionality of the communication layer. This part of ISO 10681 specifies an unacknowledged and acknowledged communication layer protocol for the exchange of data with known or unknown length between network nodes, e.g. from ECU to ECU, or between a diagnostic tester equipment and an ECU. If the data to be transferred do not fit into a single L_PDU, a segmentation method is provided.

In order to describe the function of the communication layer, services provided to upper layers and the internal operation of the communication layer have to be considered.

5.2 Services provided by communication layer to upper layers

The service interface defines a set of services that are needed to access the functions offered by the communication layer, i.e. transmission/reception of data and setting of protocol parameters.

Four types of services are defined.

a) Communication services

These services, of which the following are defined, enable the transfer of up to 64 kbytes of data.

1) C_Data.request

This service is used to request the transfer of data. If necessary, the communication layer segments the data.

2) C_Data_STF.indication

This service is used to signal the beginning of a segmented message reception to the upper layer.

3) C_Data.indication

This service is used to provide received data to the upper layer.

4) C_Data.confirm

This service confirms to the upper layer that the requested service has been carried out (successfully or not).

b) Protocol parameter setting services

These services, of which the following are defined, enable the dynamic setting of protocol parameters.

1) C_ChangeParameter.request

This service is used to request the dynamic setting of specific internal parameters.

2) C_ChangeParameter.confirm

This service confirms to the upper layer that the request to change a specific parameter has been carried out (successfully or not).

3) C_GetParameter.request

This service is used to request the value of a communication layer parameter for a given connection.

4) C_GetParameter.confirm

This service is used to return the value of a communication layer parameter for a given connection.

c) Status services

1) C_GetStatus.request

This service is used to request the status of a transfer of data (transmit/receive).

2) C_GetStatus.confirm

This service confirms to the upper layer the status of the transfer of data (transmit/receive).

d) Transmission control services

C_Cancel.request

This service is used to request cancellation of an ongoing message transmission. This request can only be issued by the sender of a message, after the message transmission has been started via a C_Data.request service primitive.

5.3 Internal operation of communication layer

5.3.1 General

The internal operation of the communication layer provides the following methods for segmentation, transmission with flow control, and reassembly:

— transmission of a message with a known message length;

— transmission of a message with an unknown but finite message length;

— acknowledgement of the transmission with a retry mechanism.

The main purpose of the communication layer is to perform a transfer of a message that might or might not fit in a single FlexRay frame. Messages which do not fit into a single FlexRay frame are segmented into multiple parts, where each can be transmitted in a FlexRay frame.

5.3.2 Rules

The communication layer establishes certain rules for an ongoing transmission/reception, which are briefly described here for better understanding of the examples given in 5.3.3. For details on certain frames and their usage, see 7.4.

— Segmented messages are always concluded with a LastFrame. This frame might include the last bytes of the message if they did not fit completely into the previous ConsecutiveFrame.

— An acknowledged message transmission that is started with a StartFrame_ACK is always concluded by the receiver with a FlowControl_ACK after the reception of the last frame of the message, which can either be a single StartFrame or a LastFrame (in the case of a multiframe transmission).

— The request to acknowledge the reception of a block of ConsecutiveFrames via the ConsecutiveFrame_EOB shall always be confirmed by the receiver with a FlowControl frame which indicates the status of the reception (CTS, WAIT, etc.).

— In the case of an unknown message length transmission, the upper layer of the sender either asynchronously or synchronously provides data during the ongoing message transmission via the C_Data.request service primitive.

— In the case of a known message length transmission where the amount of data fits into a single STF and is completely available for transmission, a LastFrame will not be transmitted.

— Functional requests are transmitted as unsegmented and unacknowledged messages. Any other format will be ignored by the communication layer (no error will be communicated).

— If an STFU payload length is greater than the possible payload in an STFU, then the frame shall be ignored by the receiver.

5.3.3 Message sequence charts

All examples given assume a communication between the sender and the receiver on a single subnet, not taking into account communication over gateways.

Figure 1 shows an example of an unsegmented unacknowledged message transmission with a known message length.

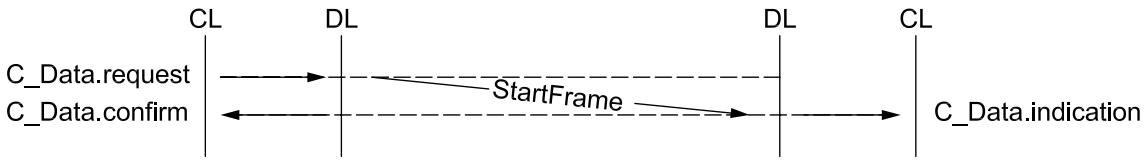

Figure 1 — Example of unsegmented unacknowledged message (known message length)

Figure 2 shows an example of an unsegmented acknowledged message transmission with a known message length.

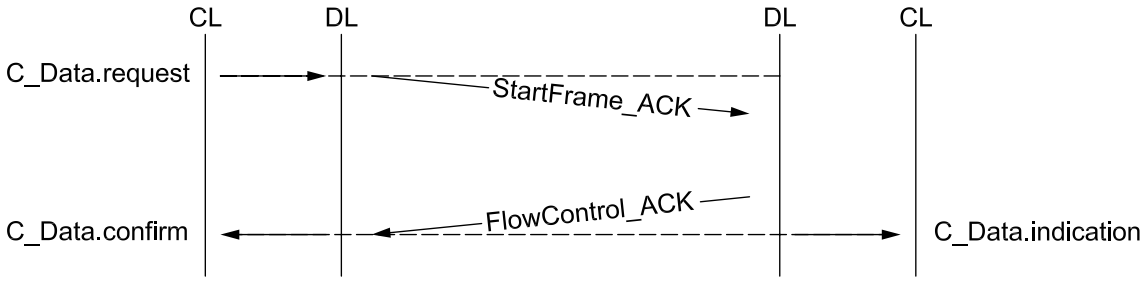

Figure 2 — Example of unsegmented acknowledged message (known message length)

Figure 3 shows an example of a segmented unacknowledged message transmission with a known message length.

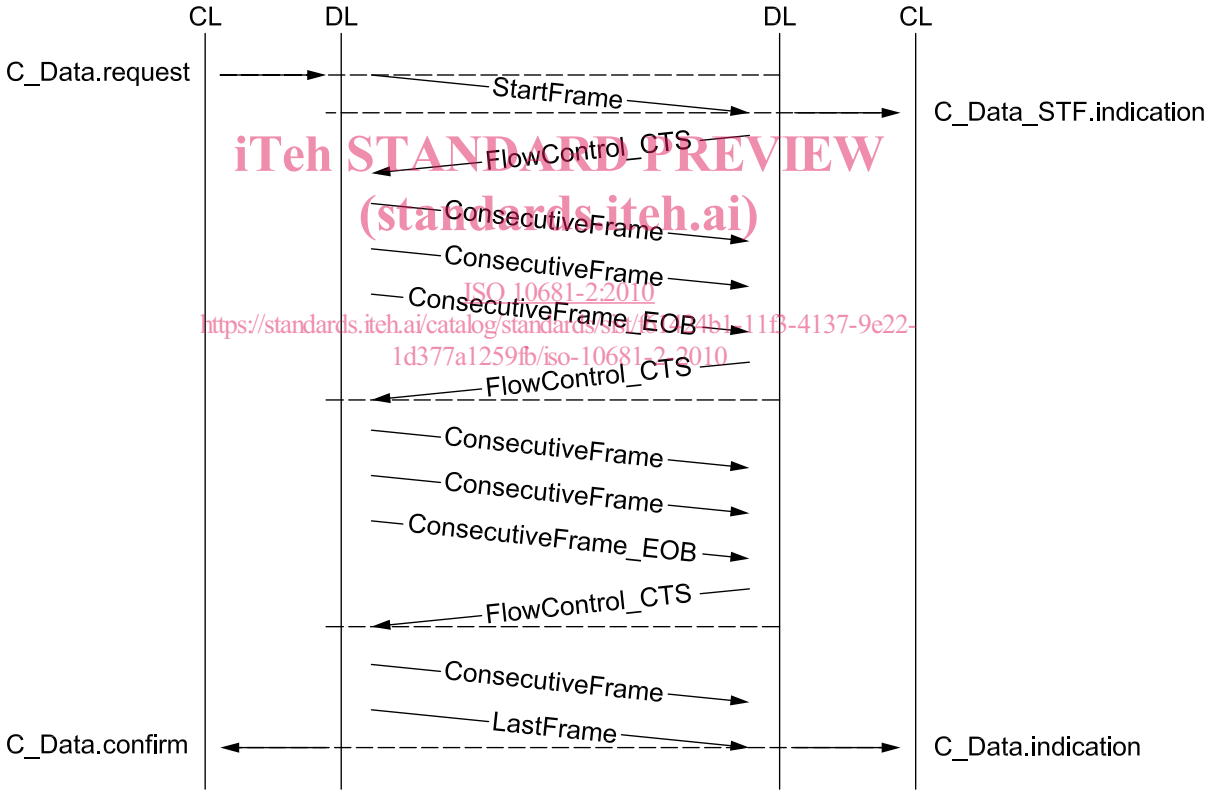

Figure 3 — Example of segmented unacknowledged message (known message length)

Figure 4 shows an example of a segmented acknowledged message transmission with a known message length.

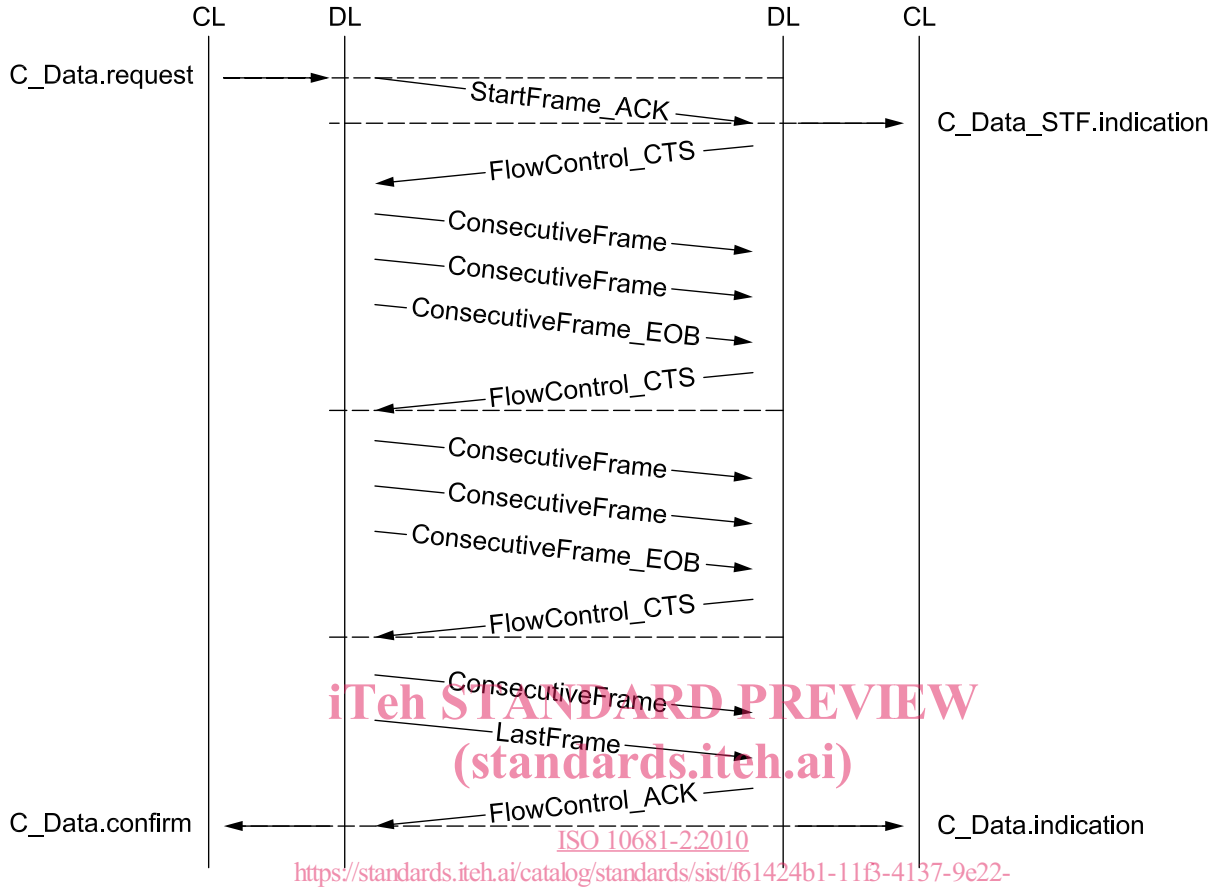

Figure 4 — Example of segmented acknowledged message (known message length)

Figure 5 shows an example of a segmented unacknowledged message transmission with an unknown message length.

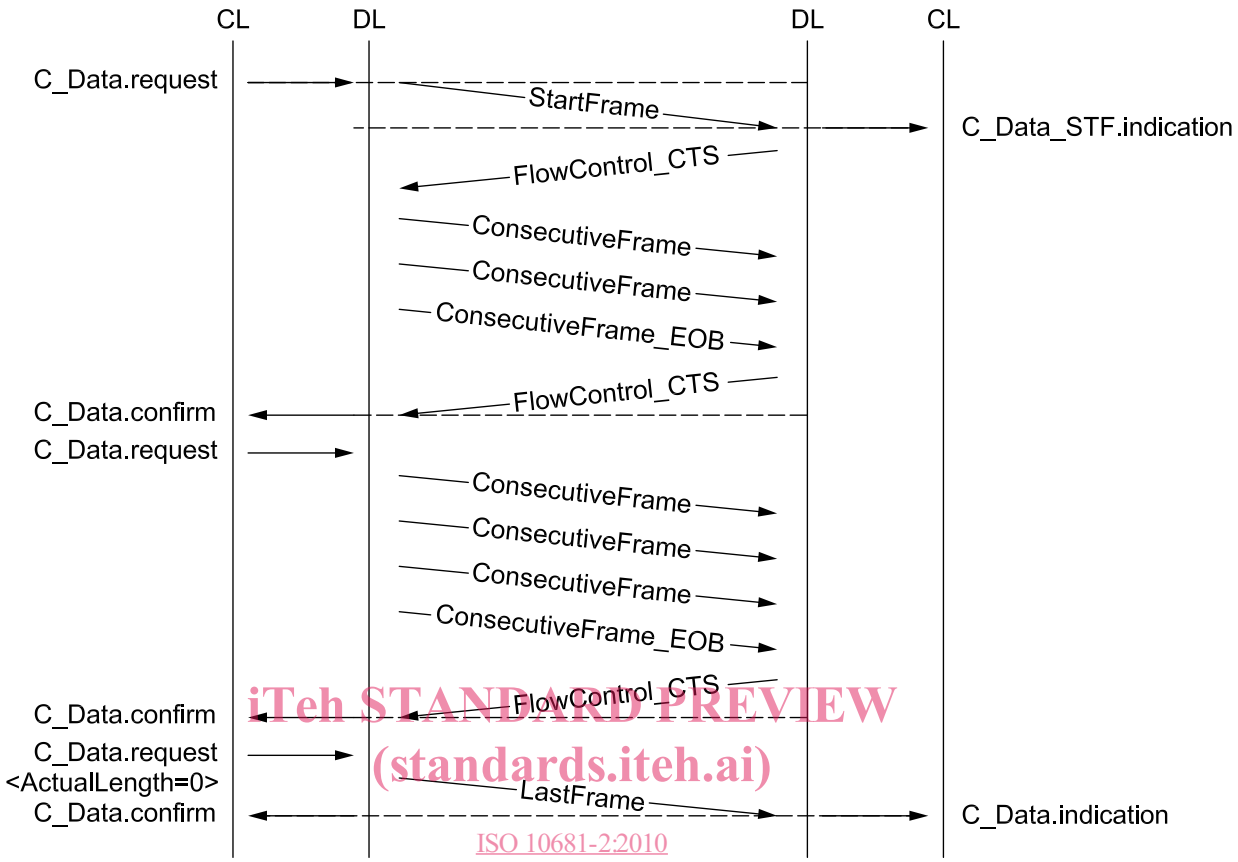

Figure 5 — Example of segmented unacknowledged message (unknown message length)