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BSI Standards Publication

Road vehicles — Clock extension peripheral interface (CXPI)

Part 2: Application layer

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Part 2: Application layer

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Partie 2: Couche Application

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CH-1214 Vernier, Geneva
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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.

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).

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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 20794 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.

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Introduction

ISO 20794 (all parts) specifies the application (partly), application layer, transport layer, network layer, data link layer, and physical layer requirements of an in-vehicle network called "clock extension peripheral interface (CXPI)".

CXPI is an automotive low-speed single-wire network. It is an enabler for reducing vehicle weight and fuel consumption by reducing wire counts to simple devices like switches and sensors.

CXPI serves as and is designed for automotive control applications, for example door control group, light switch, and HVAC (Heating Ventilation and Air Conditioning) systems.

The CXPI services, protocols, and their key characteristics are specified in different parts according to the OSI layers.

— Application and application layer:

  — application measurement and control data communication to exchange information between applications in different nodes based on message communication;

  — wake-up and sleep functionality;

  — two kinds of communication methods can be selected at system design by each node:

    i) the event-triggered method, which supports application measurement- and control-based (event-driven) slave node communication, and

    ii) the polling method, which supports slave node communication based on a periodic master schedule;

  — performs error detection and reports the result to the application;

  — application error management.

— Transport layer and network layer:

  — transforms a message into a single packet;

  — adds protocol control information for diagnostic and node configuration into each packet;

  — adds packet identifier for diagnostic and node configuration into each packet;

  — performs error detection and reports the result to higher OSI layers.

— Data link layer and physical layer:

  — provides long and short data frames;

  — adds a frame identifier into the frame;

  — adds frame information into the frame;

  — adds a cyclic redundancy check into the frame;

  — performs byte-wise arbitration and reports the arbitration result to higher OSI layers;

  — performs frame type detection in reception function;

  — performs error detection and reports the result to higher OSI layers;

  — performs Carrier Sense Multiple Access (CSMA);

  — performs Collision Resolution (CR);

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— generates a clock, which is transmitted with each bit to synchronise the connected nodes on the CXPI network;

— supports bit rates up to 20 kbit/s.

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[1], which structures communication systems into seven layers.

Figure 1 illustrates an overview of communication frameworks beyond the scope of this document including related standards:

— vehicle normal communication framework, which is composed of this document, and ISO 20794-5;

— vehicle diagnostic communication framework, which is composed of ISO 14229-1, ISO 14229-2[3], and ISO 14229-8[4];

— presentation layer standards, e.g. vehicle manufacturer specific or ISO 22901-1 ODX[6];

— lower OSI layers framework, which is composed of ISO 20794-3, ISO 20794-4, ISO 20794-6, and ISO 20794-7 conformance testing.

ISO 20794 (all parts) and ISO 14229-8[4] are based on the conventions specified in the OSI Service Conventions (ISO/IEC 10731) as they apply for all layers and the diagnostic services.

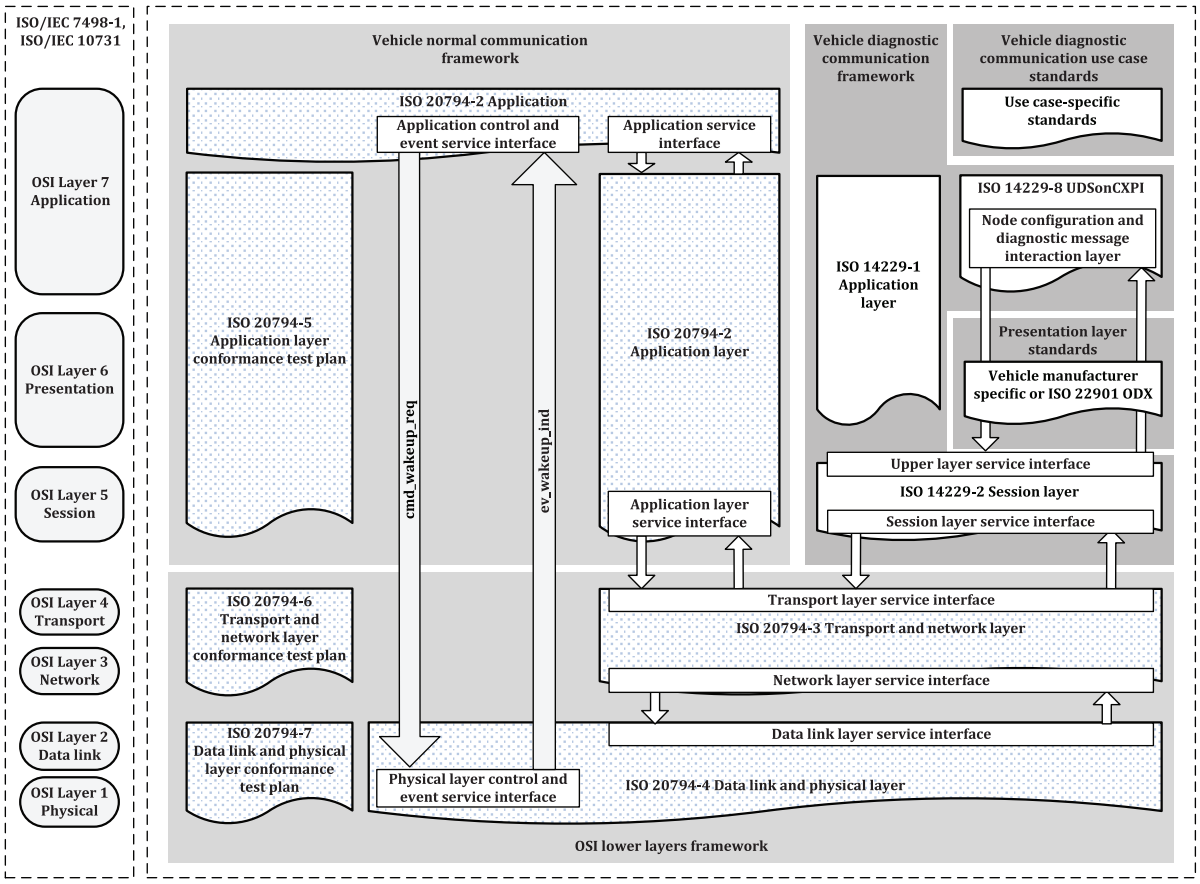

Figure 1 — ISO 20794 documents reference according to OSI model

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Road vehicles — Clock extension peripheral interface (CXPI) —

Part 2: Application layer

1 Scope

This document describes the application layer protocol including the application measurement and control data management, message transfer and fault management.

The application and application layer contain the following descriptions:

— message structure;

— communication method;

— network management (optional);

— measurement and control data; and

— error handling.

This document also specifies:

— the service interface; and

— the service interface parameters.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 20794-3, *Road vehicles — Clock extension peripheral interface (CXPI) — Part 3: Transport layer and network layer*

ISO 20794-4, *Road vehicles — Clock extension peripheral interface (CXPI) — Part 4: Data link layer and physical layer*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 20794-3, ISO 20794-4, ISO/IEC 7498-1, and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

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3.1
clock master
node that transmits *clock* (3.4) to the *lower OSI layers* (3.2)

3.2
lower OSI layer
below the application layer

3.3
master node
node that provides the *schedule* (3.10) master management (including polling method), the *primary clock* (3.6), and optionally the sleep message transmission management

3.4
clock
pulse that synchronises all nodes

3.5
normal state
state which enables transmission and reception of messages

3.6
primary clock
clock (3.4) that is provided by the *master node* (3.3)

3.7
publisher
node providing a message response containing application measurement and/or control data

3.8
request identifier
ReqId
parameter that requests dedicated measurement and/or control data

3.9
request type identifier
ReqTypeId
parameter that enables the polling method for dedicated measurement data and/or control data

3.10
schedule
origin of periodic message transmission

3.11
secondary clock
clock (3.4) that is provided by a dedicated *slave node* (3.13)

3.12
sequence
transmission and reception procedure of messages

3.13
slave node
node other than *master node* (3.3)

3.14
subscriber
master or *slave node* (3.13) that receives the data within a message

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3.15
wake-up pulse
stimulus initiated by a node used for wake-up of other nodes

4 Symbols and abbreviated terms

4.1 Symbols

$t_{clock_start_m}$	time that the master node requests the clock to the lower OSI layers at the latest
$t_{clock_stop_m}$	time that the master node stops to request the clock after master node receives the sleep message notification
$t_{cxpi_network_error}$	judgment time of the CXPI network error
t_{sleep_s}	time that each slave node transits to sleep state after the node receives the sleep message notification
t_{wakeup_m}	minimum time that master node starts the request of any request field first for the wake-up sequence
$t_{wakeup_recovery_s}$	time that slave node starts the request of the second wake-up pulse after request of the first wake-up pulse
t_{wakeup_s}	maximum time until the slave node wakes up by the wake-up sequence
$t_{wakeup_schedule_m}$	maximum time until master node starts the request of any request field (ReqId) or request field (ReqTypeId) first for the wake-up sequence

4.2 Abbreviated terms

AL	application layer
APP	application
CRC	cyclic redundancy check
DLC	data length code
ECU	electronic control unit
LSB	least significant bit
MSB	most significant bit
Mtype	message type
NMInfo	network management information
NormalCom	normal communication
OSI	open systems interconnection
param	parameter
PDU	protocol data unit
ReqId	request identifier

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ReqTypeId	request type identifier
SCT	sequence count
SI	service interface
SIP	service interface parameter

5 Conventions

This document is based on the conventions discussed in the OSI Service Conventions as specified in ISO/IEC 10731.

6 Introduction to application and application layer

6.1 Application properties

The application has the following properties:

— communication methods;

— message types;

— network management (optional wake-up, sleep);

— state management (state machine);

— measurement and/or control data; and

— error handling.

6.2 Application layer properties

The application layer has the following properties:

— message exchange;

— message structure; and

— service interface and parameters.

6.3 Message transmission

A message consists of a request field and a response field. The node that corresponds to a request identifier composed in the request field can transmit the response field.

6.4 Communication methods

Two communication methods are supported:

— Event-triggered method

Each node can request a request protected identifier field and response field based on an internal event occurrence.

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— Polling method

The master node requests a request protected type identifier field (event request in polling method) to the lower OSI layers and then each node can transmit a request protected identifier field. The node corresponding to the request protected identifier field transmits the response field.

6.5 Message types

The application layer supports the following message types:

— request message field;

— response message field; and

— request sleep message field.

6.6 Error handling

The error handling is based on the following measures:

— CXPI network errors; and

— sequence count error (optional).

7 Service interface parameters (SIP)

7.1 SIP — General

The following subclauses specify the service interface parameters and data types, which are used by the application and application layer services.

7.2 SIP — Data type definitions

This requirement specifies the data type definitions of the CXPI service interface parameters.

REQ	0.1 SIP — Data type definitions
The data types shall be in accordance to: — `Enum` = 8-bit enumeration — `Unsigned Byte` = 8-bit unsigned numeric value — `Unsigned Word` = 16-bit unsigned numeric value — `Byte Array` = sequence of 8-bit aligned data — `2-bit Bit String` = 2-bit binary coded — `8-bit Bit String` = 8-bit binary coded — `16-bit Bit String` = 16-bit binary coded	

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