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Road vehicles — Clock extension peripheral interface (CXPI) —

Part 6: Transport and network layer conformance test plan

Véhicules routiers — Interface périphérique d'extension d'horloge (CXPI) —

Partie 6: Plan de test de conformité des couches transport et réseau

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Foreword

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A list of all parts in the ISO 20794 series can be found on the ISO website.

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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 Condition) 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[2], 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 ISO 20794-2 and ISO 20794-5[6];

— vehicle diagnostic communication framework, which is composed of ISO 14229-1[3], ISO 14229-2[4] and ISO 14229-8[5];

— presentation layer standards, e.g. vehicle manufacturer specific or ISO 22901-1 ODX[8];

— lower OSI layers framework, which is composed of ISO 20794-3, ISO 20794-4, this document and ISO 20794-7[7].

ISO 20794 (all parts) and ISO 14229-8[5] are based on the conventions specified in the OSI Service Conventions (ISO/IEC 10731[2]) as they apply for all layers and the diagnostic services.

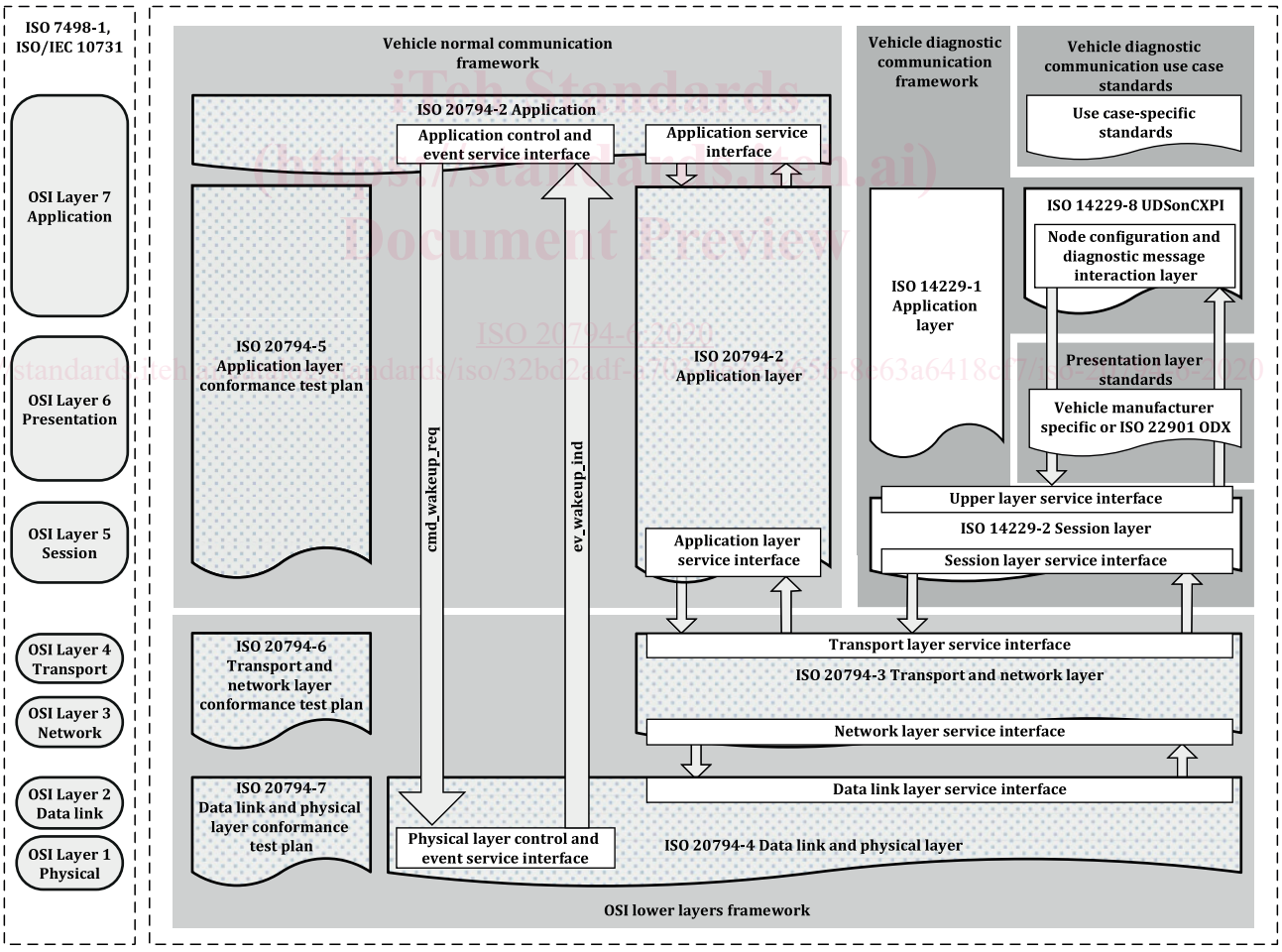

Figure 1 — ISO 20794 document reference according to OSI model

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Road vehicles — Clock extension peripheral interface (CXPI) —

Part 6: Transport and network layer conformance test plan

1 Scope

This document specifies the transport and network layer conformance test plan, which tests the transportation of diagnostic communication, node configuration data and network layer services using the service interface parameters reported by the lower OSI layers and submitted to the higher OSI layers.

The transport layer and network layer conformance test plan contain the following descriptions:

— concept of operation conformance test plan;

— transport layer protocol conformance test plan;

— network layer services conformance test plan; and

— error detection conformance test plan.

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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.

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ISO/IEC 7498-1, *Information processing systems — Open systems interconnection — Basic reference model*

ISO 20794-2:2020, *Road vehicles — Clock extension peripheral interface (CXPI) — Part 2: Application layer*

ISO 20794-3:2020, *Road vehicles — Clock extension peripheral interface (CXPI) — Part 3: Transport and network layer*

ISO 20794-4:2020, *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/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/

3.1
lower OSI layer
OSI layer lower than transport layer and network layer

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3.2
master node
node that provides the schedule master management (include ReqTypeId transmission), the primary clock and optionally the sleep message transmission management

3.3
slave node
node other than *master node* (3.2) connected to the CXPI network

3.4
protocol data unit
data byte array that contains data and the other information to establish communication

3.5
protocol control information
information that contains message type and data length

3.6
protocol control information type
information that identifies the message type

3.7
REPEAT
pseudo code command for an iteration

3.8
REPEAT END
pseudo code command for ending an iteration

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3.9
single message data length
information that identifies the data length

3.10
node address
address information that identifies target node

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3.11
result
transmission or reception status to report to the higher OSI layers

3.12
status report message
message which enable to observe any error occurrence and internal state on the CXPI network

Note 1 to entry: This message consists with the TST_MSG_05_REQ_PID_ERRBIT and the TST_MSG_16_RESP_ERRBIT_0–12.

4 Symbols and abbreviated terms

4.1 Symbols

---	empty cell/undefined
kbit/s	kilobit per second

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4.2 Abbreviated terms

ASP	abstract service primitive
CRC	cyclic redundancy check
CTC	conformance test case
Err	error
ETS	enhanced testability service
IUT	implementation under test
MSG	message
N_NAD	network layer node address
N_PDU	network layer protocol data unit
NL	network layer
OSI	open systems interconnection
PDU	protocol data unit
PID	protected identifier
PCO	point of control and observation
ReqId	request identifier
ReqTypeId	request type identifier
SUT	system under test
T_PCI	transport layer protocol control information
T_PCItype	transport layer protocol control information type
T_PCI_DL	transport layer protocol control information single message data length
T_PDU	transport layer protocol data unit
TL	transport layer
TST	test

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5 Conventions

This document is based on OSI service conventions as specified in ISO/IEC 10731[2] and ISO/IEC 9646-1[1] for conformance test system setup.

6 General test specification considerations

6.1 General

This document covers the conformance test cases (CTC) to verify the requirements described in ISO 20794-3.

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6.2 Test conditions

Tests can be performed at room temperature, if the temperature is in the range of 15° C to 35° C. Also, the tests shall be performed under room EMI (electro-magnetic interference) conditions.

6.3 IUT requirements

The occurrence of the error specified in ISO 20794-2:2020, 9.6.8 shall be notified to the application.

The IUT shall be initialised in the CTC respectively.

6.4 CTC definition

The definition of each test case specifies, whether the IUT is a master or a slave node. Each CTC is defined in the structure as defined in Table 1.

Table 1 — CTC definition example

Item	Content
CTC # – Title	[OSI layer #].CTC_[number_name] E.g. 3.CTC_4.1 – Master node – NL error detection (N_As timeout)
Purpose	E.g. This CTC verifies the master node to detect the error of an N_As timeout. E.g. This CTC verifies that timeout error detection shall be performed correctly.
Reference	REQ document, REQ number – REQ name E.g. ISO 20794-2:2020, REQ 3.13 NL – Timing definition – NL – Timing parameters;
Prerequisite	The test system set-up shall be in accordance with Figure 2.
Set-up	— The IUT shall be configured as a master node or a slave node. — The IUT shall be configured to support N_ErrDet2 (see 6.6.7), TST_MSG_01_REQ_PID, TST_MSG_10_RESP_0–12, TST_MSG_05_REQ_PID_ERRBIT and TST_MSG_16_RESP_ERRBIT_0–12. — The bit rate shall be set to the default value (see 6.6.2). — The SUT shall be initialised to the default state (see 6.7).
Step	1. The IUT shall transmit the TST_MSG_01_REQ_PID and the TST_MSG_10_RESP_0–12. 2. The LT shall transmit the TST_MSG_01_REQ_PID as the higher priority than the IUT and the TST_MSG_10_RESP_0–12 to generate arbitration lost on the IUT. 3. The LT shall transmit the TST_MSG_05_REQ_PID_ERRBIT.
Iteration	Definition of repetitions of test procedure steps. EXAMPLE REPEAT step 1 to step 2, 1 000 times; … REPEAT END
Expected response	Define the expected behaviour of the IUT by checking on the CXPI network when the test step is executed. EXAMPLE After step 3: The IUT shall transmit the TST_MSG_16_RESP_ERRBIT_0–12 with Err_NL_TIMEOUT_A = TRUE. The LT shall receive the TST_MSG_16_RESP_ERRBIT_0–12 with Err_NL_TIMEOUT_A = TRUE and report to the UT.
Remark	E.g. "---" if no remark

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