INTERNATIONAL STANDARD

**ISO 17458-1**

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# Road vehicles— FlexRay communications system —

## Part 1: General information and use case definition

*Véhicules routiers — Système de communications FlexRay — Partie 1: Information générale et définition de cas d'utilisation*



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# Foreword

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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 17458-1 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.



ISO 17458 consists of the following parts, under the general title *Road vehicles — FlexRay communications system*:



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

— *Part 2: Data link layer specification*

— *Part 3: Data link layer conformance test specification*

— *Part 4: Electrical physical layer specification*

— *Part 5: Electrical physical layer conformance test specification*

# Introduction

The FlexRay communications system is an automotive focused high speed network and was developed with several main objectives which were defined beyond the capabilities of established standardized bus systems like CAN and some other proprietary bus systems. Some of the basic characteristics of the FlexRay protocol are synchronous and asynchronous frame transfer, guaranteed frame latency and jitter during synchronous transfer, prioritization of frames during asynchronous transfer, single or multi-master clock synchronization, time synchronization across multiple networks, error detection and signalling, and scalable fault tolerance.

The FlexRay communications system is defined for advanced automotive control applications. It serves as a communication infrastructure for future generation high-speed control applications in vehicles by providing:

— A message exchange service that provides deterministic cycle based message transport;

— Synchronization service that provides a common time base to all nodes;

— Start-up service that provides an autonomous start-up procedure;

— Error management service that provides error handling and error signalling;

— Wakeup service that addresses the power management needs;



Since start of development the automotive industry world-wide supported the specification development. The FlexRay communications system has been successfully implemented in production vehicles today.



The ISO 17458 series specifies the use cases, the communication protocol and physical layer requirements of an in-vehicle communication network called "FlexRay communications system".

This part of ISO 17458 has been established in order to define the use cases for vehicle communication systems implemented on a FlexRay data link.

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 protocol and physical layer requirements specified by ISO 17458 are broken into:

— Diagnostic services (layer 7), specified in ISO 14229-1 [3], ISO 14229-4 [5];

— Presentation layer (layer 6), vehicle manufacturer specific;

— Session layer services (layer 5), specified in ISO 14229-2 [4];

— Transport layer services (layer 4), specified in ISO 10681-2 [1];

— Network layer services (layer 3), specified in ISO 10681-2 [1];

— Data link layer (layer 2), specified in ISO 17458-2, ISO 17458-3;

— Physical layer (layer 1), specified in ISO 17458-4, ISO 17458-5;

in accordance with Table 1.

**Table 1 — FlexRay communications system specifications applicable to the OSI layers**

| Applicability | OSI 7 layers | ISO 17458 FlexRay communications system | Vehicle manufacturer enhanced diagnostics |
|---|---|---|---|
| Seven layer according to ISO 7498-1 and ISO/IEC 10731 | Application (layer 7) | vehicle manufacturer specific | ISO 14229-1, ISO 14229-4 |
| | Presentation (layer 6) | vehicle manufacturer specific | vehicle manufacturer specific |
| | Session (layer 5) | vehicle manufacturer specific | ISO 14229-2 |
| | Transport (layer 4) | vehicle manufacturer specific | ISO 10681-2 |
| | Network (layer 3) | vehicle manufacturer specific | |
| | Data link (layer 2) | ISO 17458-2, ISO 17458-3 | |
| | Physical (layer 1) | ISO 17458-4, ISO 17458-5 | |

Table 1 shows ISO 17458 Parts 2 – 5 being the common standards for the OSI layers 1 and 2 for the FlexRay communications system and the vehicle manufacturer enhanced diagnostics.

The FlexRay communications system column shows vehicle manufacturer specific definitions for OSI layers 3 – 7.

The vehicle manufacturer enhanced diagnostics column shows application layer services covered by ISO 14229-4 which have been defined in compliance with diagnostic services established in ISO 14229-1, but are not limited to use only with them. ISO 14229-4 is also compatible with most diagnostic services defined in national standards or vehicle manufacturer's specifications. The presentation layer is defined vehicle manufacturer specific. The session layer services are covered by ISO 14229-2. The transport protocol and network layer services are specified in ISO 10681.

# Road vehicles — FlexRay communications system — Part 1: General information and use case definition

## 1 Scope

This part of ISO 17458 gives an overview of the structure and the partitioning of ISO 17458 and shows the relation between the different parts. In addition, it outlines the use case scenarios where the ISO 17458 series will be used. The terminology defined in this part of ISO 17458 is common for all FlexRay communication systems and is used throughout all parts of ISO 17458.

## 2 Terms, definitions, symbols and abbreviated terms

### 2.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.



**2.1.1**
**active star**
**AS**
active element which passes bus signals automatically from one input port to several output ports, where usually a passive net is plugged to each port



NOTE1 An AS refreshes the bus signal slopes and levels; an AS does not refresh the bit-timing.

NOTE2 An AS may be implemented in a monolithic way or a non-monolithic way.

NOTE3 Optionally an AS may have a CC interface included.

**2.1.2**
**branch**
component within active star topologies

NOTE A branch can be built from a point-to-point connection, a linear bus or a passive star.

**2.1.3**
**bus driver**
**BD**
physical interface between the CC and the wiring harness

NOTE A BD is a mandatory FlexRay component that converts the data stream of the physical interface and supports the node with a power mode controlling optionally.

**2.1.4**
**cable**
FlexRay transmission line.

**2.1.5**
**cluster**
communication system of multiple nodes connected via at least one communication channel directly (bus topology), by active stars (star topology) or by a combination of bus and star connections (hybrid topologies)

NOTE Clusters can be coupled by gateways.

**2.1.6**
**communication channel**
node connection through which signals are conveyed for the purpose of communication

NOTE FlexRay allows a single CC to distribute data-frames independent from each other on two different hardware paths or topologies. From an abstract view each path is named “communication channel” (short: "channel"). The two channels are distinguished by using the extensions "A" and "B".

**2.1.7**
**communication controller**
**CC**
electronic component in a node that is responsible for implementing the protocol aspects of the FlexRay communications system

**2.1.8**
**communication element**
symbol and frame

NOTE FlexRay distinguishes two types of communication elements which can be transmitted on the communication channel: symbols and frames.



**2.1.9**
**communication cycle**
one complete instance of the communication structure that is periodically repeated to comprise the media access method of the FlexRay system



NOTE The communication cycle consists of a static segment, an optional dynamic segment, an optional symbol window, and a network idle time.

Figure 1 illustrates the segmentation of a communication cycle during FlexRay´s normal operation.

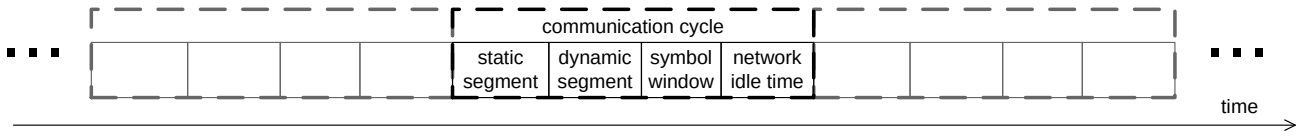


**Figure 1 — Segmentation of a communication cycle during normal operation**

The static segment is configured into a selectable number of static slots. The segmentation in the time domain is based on FlexRay´s distributed clock. FlexRay frames are transmitted synchronously during these static slots.

The dynamic segment is configured into mini slots. They support prioritised event driven transmission of FlexRay frames.

The symbol window is used to transmit FlexRay symbols which support e.g. wake-up of a FlexRay communication system.

The network idle time is used for clock correction.

**2.1.10**
**gateway**
node that is connected to two or more independent communication networks that allows information to flow between the networks

**2.1.11**
**host**
part of an ECU where the application software is executed, separated by the CHI from the FlexRay protocol engine

NOTE The host offers interfaces which enable the application software to control the CC and the BD.

**2.1.12**
**hybrid topology**
design of a communication cycle using various topology components

EXAMPLE An AS with one branch as point-to-point connection, one branch as linear bus and one branch as passive star.

**2.1.13**
**passive net**
summary of all possible implementations of passive connections among FlexRay BDs and Ass

NOTE A passive summarizes all point-to-point connections, linear busses and passive stars.

**2.1.14**
**physical layer**
BDs, ASs, CC I/O stages, cables, connectors, common mode filters, ESD protection circuits, termination networks etc.



NOTE All timing relevant hard-ware components are included which are needed to transfer communication elements among the protocol machines.



**2.1.15**
**point-to-point**
two terminated FlexRay nodes which are linked by a single FlexRay cable without any stub

**2.1.16**
**splice**
implementation of a connection-point where 3 or more transmission lines are plugged together.

NOTE A splice may contain passive components to damp radiation, e.g.a splice in a linear bus allows connecting a stub to a FlexRay node.

**2.1.17**
**stub**
single FlexRay cable connected to the centre of a passive star or to a linear bus (short: plugged to a splice)

NOTE1 A stub represents a component within passive nets. A stub consists of a single FlexRay cable connected to the centre of a passive star or to a linear bus (short: plugged to a splice).

NOTE2 The stub ends at the BD pins within an FlexRay node.

**2.1.18**
**topology**
distributed FlexRay system which consists of several components like nodes, busses, active and passive stars etc.

NOTE The topology represents the non-hierarchical flat geometric structure of a FlexRay communication channel.

**2.1.19**
**wiring harness**
summary of all components inside the component “vehicle wiring harness” to transmit FlexRay communication elements

NOTE The FlexRay wiring harness consists of

- connectors to plug ECUs,
- in-line connectors,
- cables,
- splices etc.

## 2.2 Abbreviated terms

| | |
|---|---|
| AM | amplitude modulation |
| AS | active star |
| BD | bus driver |
| BD/AS | bus driver or active star |
| CC | communication controller |
| CW | continuous wave |
| ECU | electronic control unit |
| EMC | electromagnetic compatibility |
| EPL | electrical physical layer |
| ESD | electro static discharge |
| SAP | service access point |



# 3 Conventions

ISO 17458, ISO 10681 [1] and ISO 14229-4 [5] are based on the conventions specified in the OSI Service Conventions (ISO/IEC 10731) [2] as they apply for physical layer, protocol, network & transport protocol and diagnostic services.

# 4 Document overview

## 4.1 General

ISO 17458 has been established in order to define common requirements for vehicle communication systems implemented on a FlexRay communication data link.

## 4.2 Document overview and structure

The ISO 17458 series provides an implementer with all documents and references required to support the implementation of the requirements related to.

— Part 1: General information and use case definitions
This part provides an overview of the document set and structure along with the use case definitions and a common set of resources (definitions, references) for use by all subsequent parts.

— Part 2: Data link layer specification
This part specifies the requirements for implementations of the FlexRay protocol on the logical level of abstraction. Hardware related properties are hidden in the defined constrains.

— Part 3: Data link layer conformance test specification
This part specifies tests to check the compliance of a given protocol implementation (logical level of abstraction) to the Data link layer specification.

— Part 4: Electrical physical layer specification
This part specifies the requirements for implementations of active hardware components which are necessary to interconnect several distributed protocol implementations. Requirements for necessary passive components are specified partly.

— Part 5: Electrical physical layer conformance test specification
This part specifies tests to check the compliance of a given active hardware component implementation to the electrical physical layer specification.



## 4.3 Open Systems Interconnection (OSI) model

ISO 17458 is based on the Open Systems Interconnection (OSI) Basic Reference Model as specified in ISO/IEC 7498 which structures communication systems into seven layers.



All parts of ISO 17458 are guided by the OSI service conventions as specified in ISO/IEC 10731 to the extent that they are applicable to diagnostic services. These conventions define the interaction between the service user and the service provider through service primitives.

The aim of this subclause is to give an overview of the OSI model and show how it has been used as a guideline for this part of ISO 17458. It also shows how the OSI service conventions have been applied to ISO 17458.

The OSI model structures data communication into seven layers called (top down) *Application layer* (layer 7), *Presentation layer*, *Session layer*, *Transport layer*, *Network layer*, *Data Link layer* and *Physical layer* (layer 1). A subset of these layers is used in ISO 17458.

ISO 17458 specifies data link layer and physical layer for the FlexRay communications system.

The purpose of each layer is to provide services to the layer above. The active parts of each layer, implemented in software, hardware or any combination of software and hardware, are called *entities*. In the OSI model, communication takes place between entities of the same layer in different nodes. Such communicating entities of the same layer are called *peer entities*.

The services provided by one layer are available at the *Service Access Point* (SAP) of that layer. The layer above can use them by exchanging data parameters

ISO 17458 distinguishes between the services provided by a layer to the layer above it and the protocol used by the layer to send a message between the peer entities of that layer. The reason for this distinction is to make the services, especially the application layer services and the transport layer services, reusable also for other types of networks than FlexRay. In this way the protocol is hidden from the service user and it is possible to change the protocol if special system requirements demand it.

## 4.4 Document reference according to OSI model

Figure 2 illustrates the document references.

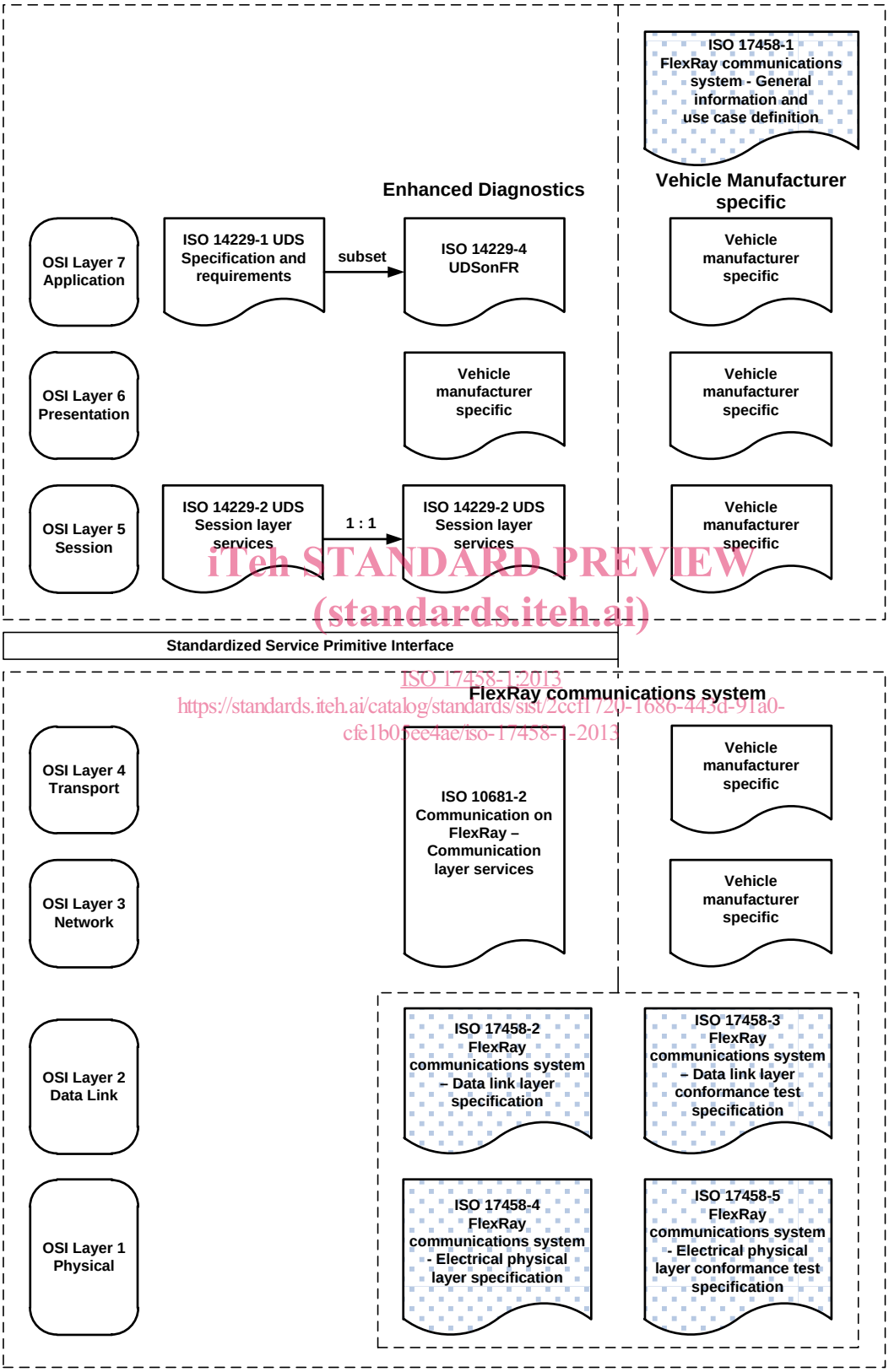




**Figure 2 — FlexRay document reference according to OSI model**