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Road vehicles — Diagnostics on Controller Area Networks (CAN) —

Part 2: Network layer services

Véhicules routiers — Diagnostic sur gestionnaire de réseau de communication (CAN) —

Partie 2: Services de la couche réseau

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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

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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 15765-2 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

ISO 15765 consists of the following parts, under the general title *Road vehicles — Diagnostics on Controller Area Networks (CAN)*:

— *Part 1: General information*

— *Part 2: Network layer services*

— *Part 3: Implementation of unified diagnostic services (UDS on CAN)*

— *Part 4: Requirements for emissions-related systems*

Introduction

This part of ISO 15765 has been established in order to define common requirements for vehicle diagnostic systems implemented on a Controller Area Network (CAN) communication link, as specified in ISO 11898. Although primarily intended for diagnostic systems, it also meets requirements from other CAN-based systems needing a network layer protocol.

To achieve this, it is based on the Open Systems Interconnection (OSI) Basic Reference Model specified in ISO/IEC 7498 and ISO/IEC 10731, which structures communication systems into seven layers. When mapped on this model, the services specified by ISO 15765 are divided into

— unified diagnostic services (layer 7), specified in ISO 15765-3,

— network layer services (layer 3), specified in this part of ISO 15765,

— CAN services (layers 1 and 2), specified in ISO 11898,

in accordance with Table 1.

The application layer services covered by ISO 15765-3 have been defined in compliance with diagnostic services established in ISO 14229-1 and ISO 15031-5, but are not limited to use only with them. ISO 15765-3 is also compatible with most diagnostic services defined in national standards or vehicle manufacturer's specifications.

The network layer services covered by this part of ISO 15765 have been defined to be independent of the physical layer implemented, and a physical layer is only specified for legislated OBD.

For other application areas, ISO 15765 can be used with any CAN physical layer.

Table 1 — Enhanced and legislated OBD diagnostic specifications applicable to the OSI layers

Open Systems Interconnection (OSI) layers	Vehicle manufacturer enhanced diagnostics	Legislated on-board diagnostics (OBD)
Diagnostic application	User defined	ISO 15031-5
Application layer	ISO 15765-3	ISO 15031-5
Presentation layer	N/A	N/A
Session layer	ISO 15765-3	N/A
Transport layer	N/A	N/A
Network layer	ISO 15765-2	ISO 15765-4
Data link layer	ISO 11898-1	ISO 15765-4
Physical layer	User defined	ISO 15765-4

Road vehicles — Diagnostics on Controller Area Networks (CAN) —

Part 2: Network layer services

1 Scope

This part of ISO 15765 specifies a network protocol tailored to meet the requirements of CAN-based vehicle network systems on controller area networks as specified in ISO 11898. It has been defined in accordance with the diagnostic services established in ISO 14229-1 and ISO 15031-5, but is not limited to use with them, and is also compatible with most other communication needs for in-vehicle networks. The protocol specifies an unconfirmed communication.

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 11898-1, *Road vehicles — Controller area network (CAN) — Part 1: Data link layer and physical signalling*

ISO/IEC 7498 (all parts), *Information technology — Open Systems Interconnection — Basic Reference Model*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the terms and definitions given in ISO 7498, and the following abbreviated terms, apply.

BS	block size
CF	consecutive frame
confirm	confirmation service primitive
ECU	electronic control unit
FC	flow control
FF	first frame
FF_DL	first frame data length
FS	flow status
indication	indication service primitive

Mtype	message type
N_AE	network address extension
N_AI	address information
N_Ar	network layer timing parameter Ar
N_As	network layer timing parameter As
N_Br	network layer timing parameter Br
N_Bs	network layer timing parameter Bs
N_ChangeParameter	network layer service name
N_Cr	network layer timing parameter Cr
N_Cs	network layer timing parameter Cs
N_Data	network data
N_PCI	network protocol control information
N_PCItype	network protocol control information type
N_PDU	network protocol data unit
N_SA	network source address
N_SDU	network service data unit
N_TA	network target address
N_TAtype	network target address type
N_USData	network layer unacknowledged segmented data transfer service name
NWL	network layer
request	request service primitive
r	receiver
s	sender
SF	single frame
SF_DL	single frame data length
SN	sequence number
STmin	separation time min.

4 Network layer overview

4.1 General

This clause describes the overall functionality of the network layer. This part of ISO 15765 specifies an unconfirmed network layer communication protocol for the exchange of data between network nodes, e.g. from ECU to ECU, or between external test equipment and an ECU. If the data to be transferred do not fit into a single CAN frame, a segmentation method is provided.

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

4.2 Services provided by network layer to higher layers

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

Two types of services are defined.

a) Communication services

These services, of which the following are defined, enable the transfer of up to 4 095 bytes of data.

1) **N_USData.request**

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

2) **N_USData_FF.indication**

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

3) **N_USData.indication**

This service is used to provide received data to the higher layers.

4) **N_USData.confirm**

This service confirms to the higher layers 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) **N_ChangeParameter.request**

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

2) **N_ChangeParameter.confirm**

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

4.3 Internal operation of network layer

The internal operation of the network layer provides methods for segmentation, transmission with flow control, and reassembly. The main purpose of the network layer is to transfer messages that might or might not fit in a single CAN frame. Messages that do not fit into a single CAN frame are segmented into multiple parts, where each can be transmitted in a CAN frame.

Figure 1 shows an example of an unsegmented message transmission.

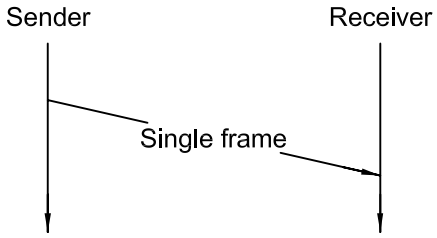

Figure 1 — Example of unsegmented message

Figure 2 shows an example of a segmented message transmission.

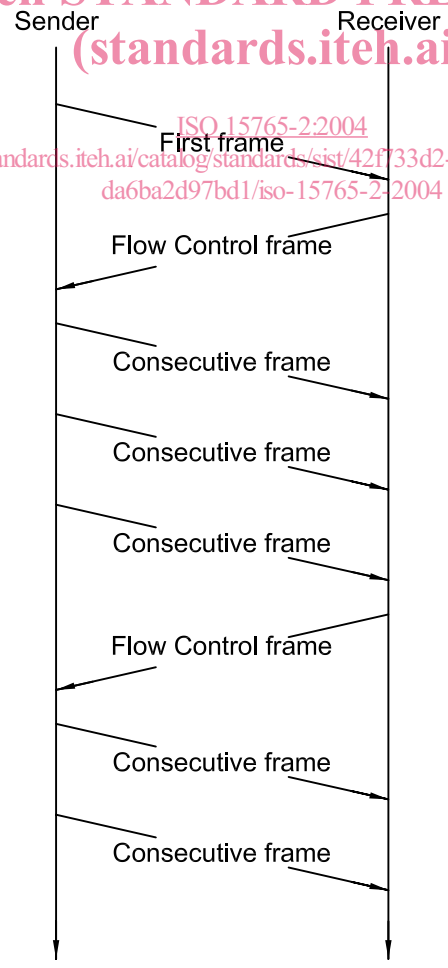

Figure 2 — Example of segmented message

Flow control is used to adjust the sender to the network layer capabilities of the receiver. This flow control scheme allows the use of diagnostic gateways and sub-networks.

ISO 15765 specifies three different addressing formats: normal, extended and mixed.

5 Network layer services

5.1 General

All network layer services have the same general structure. To define the services, three types of service primitives are specified:

— a *service request primitive*, used by higher communication layers or the application to pass control information and data required to be transmitted to the network layer;

— a *service indication primitive*, used by the network layer to pass status information and received data to upper communication layers or the application;

— a *service confirmation primitive* used by the network layer to pass status information to higher communication layers or the application.

This service specification does not specify an application programming interface, but only a set of service primitives that are independent of any implementation.

All network layer services have the same general format. Service primitives are written in the form:

service_name.type (
parameter A,
parameter B,
parameter C,
...
)

where “service_name” is the name of the service, e.g. N_USData, “type” indicates the type of the service primitive, and “parameter A, parameter B, parameter C, ...” are the N_SDU as a list of values passed by the service primitive.

The service primitives define how a service user (e.g. diagnostic application) cooperates with a service provider (e.g. network layer). The following service primitives are specified in this International Standard: request, indication and confirm.

— Using the service primitive *request* (service_name.request) a service user requests a service from the service provider.

— Using the service primitive *indication* (service_name.indication), the service provider informs a service user about an internal event of the network layer or the service request of a peer protocol layer entity service user.

— With the service primitive *confirm* (service_name.confirm) the service provider informs the service user about the result of a preceding service request of the service user.

5.2 Specification of network layer service primitives

5.2.1 N_USData.request

The service primitive requests transmission of <MessageData> with <Length> bytes from the sender to the receiver peer entities identified by the address information in N_SA, N_TA, N_TAtype, and N_AE [1)] (see 5.3 for parameter definition).

Each time the N_USData.request service is called, the network layer shall signal the completion (or failure) of the message transmission to the service user by means of the issuing of an N_USData.confirm service call:

N_USData.request (
Mtype
N_SA
N_TA
N_TAtype
N_AE [1)]
<MessageData>
<Length>
)

5.2.2 N_USData.confirm

The N_USData.confirm service is issued by the network layer. The service primitive confirms the completion of an N_USData.request service identified by the address information in N_SA, N_TA, N_TAtype, and N_AE 1). The parameter <N_Result> provides the status of the service request (see 5.3 for parameter definition).

N_USData.confirm (
Mtype
N_SA
N_TA
N_TAtype
N_AE [1)]
<N_Result>
)

5.2.3 N_USData_FF.indication

The N_USData_FF.indication service is issued by the network layer. The service primitive indicates to the adjacent upper layer the arrival of a first frame (FF) of a segmented message received from a peer protocol entity, identified by the address information in N_SA, N_TA, N_TAtype, and N_AE [1)] (see 5.3 for parameter definition). This indication shall take place upon reception of the first frame (FF) of a segmented message.

N_USData_FF.indication (
Mtype
N_SA
N_TA
N_TAtype
N_AE [1)]
<Length>
)

The N_USData_FF.indication service shall always be followed by an N_USData.indication service call from the network layer, indicating the completion (or failure) of the message reception.

---

1) Optional.

An N_USData_FF.indication service call shall only be issued by the network layer if a correct first frame (FF) message segment has been received.

If the network layer detects any type of error in a first frame (FF), then the message shall be ignored by the network layer and no N_USData_FF.indication shall be issued to the adjacent upper layer.

If the network layer receives a first frame (FF) with a data length value (FF_DL) that is greater than the available receiver buffer size, then this shall be considered as an error condition and no N_USData_FF.indication shall be issued to the adjacent upper layer.

5.2.4 N_USData.indication

The N_USData.indication service is issued by the network layer. The service primitive indicates <N_Result> events and delivers <MessageData> with <Length> bytes received from a peer protocol entity identified by the address information in N_SA, N_TA, N_TAtype, and N_AE [2)] to the adjacent upper layer (see 5.3 for parameter definition).

The parameters <MessageData> and <Length> are only valid if <N_Result> equals N_OK.

N_USData.indication (
Mtype
N_SA
N_TA
N_TAtype
N_AE [2)]
<MessageData>
<Length>
<N_Result>
)

The N_USData.indication service call is issued after the reception of a single frame (SF) message or as an indication of the completion (or failure) of a segmented message reception.

If the network layer detects any type of error in a single frame (SF), then the message shall be ignored by the network layer and no N_USData.indication shall be issued to the adjacent upper layer.

5.2.5 N_ChangeParameters.request

The service primitive is used to request the change of an internal parameter's value on the local protocol entity. The <Parameter_Value> is assigned to the <Parameter> (see 5.3 for parameter definition).

A parameter change is always possible, except after reception of the first frame (N_USData_FF.indication) and until the end of the reception of the corresponding message (N_USData.indication).

N_ChangeParameter.request (
Mtype
N_SA
N_TA
N_TAtype
N_AE [2)]
<Parameter>
<Parameter_Value>
)

This is an optional service that can be replaced by implementation of fixed parameter values.

2) Optional.