BS ISO 14229-2:2021

BSI Standards Publication

Road vehicles — Unified diagnostic services (UDS)

Part 2: Session layer services

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National foreword

This British Standard is the UK implementation of ISO 14229-2:2021. It supersedes BS ISO 14229-2:2013, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee AUE/16, Data Communication (Road Vehicles).

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Road vehicles — Unified diagnostic services (UDS) —

Part 2: Session layer services

Véhicules routiers — Services de diagnostic unifiés (SDU) —

Partie 2: Services de la couche session

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CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
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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*.

This second edition cancels and replaces the first edition (ISO 14229-2:2013), which has been technically revised.

The main changes are as follows:

— restructuration of the document;

— introduction of requirement numbers and names;

— technical content improvements based on implementation feedback from the automotive industry.

A list of all parts in the ISO 14229 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

The ISO 14229 series has been established in order to define common requirements for diagnostic systems, whatever the serial data link is.

To achieve this, the ISO 14229 series is based on the Open Systems Interconnection (OSI) Basic Reference Model in accordance with ISO/IEC 7498-1 and ISO/IEC 10731,[1] which structures communication systems into seven layers. When mapped on this model, the services used by a diagnostic tester (client) and an Electronic Control Unit (ECU, server) are structured into the following layers:

— application layer (layer 7) specified in ISO 14229-1;

— presentation layer (layer 6) specified in ISO 14229-1;

— session layer services (layer 5) specified in this document (ISO 14229-2).

Figure 1 illustrates the ISO 14229 series reference according to OSI model.

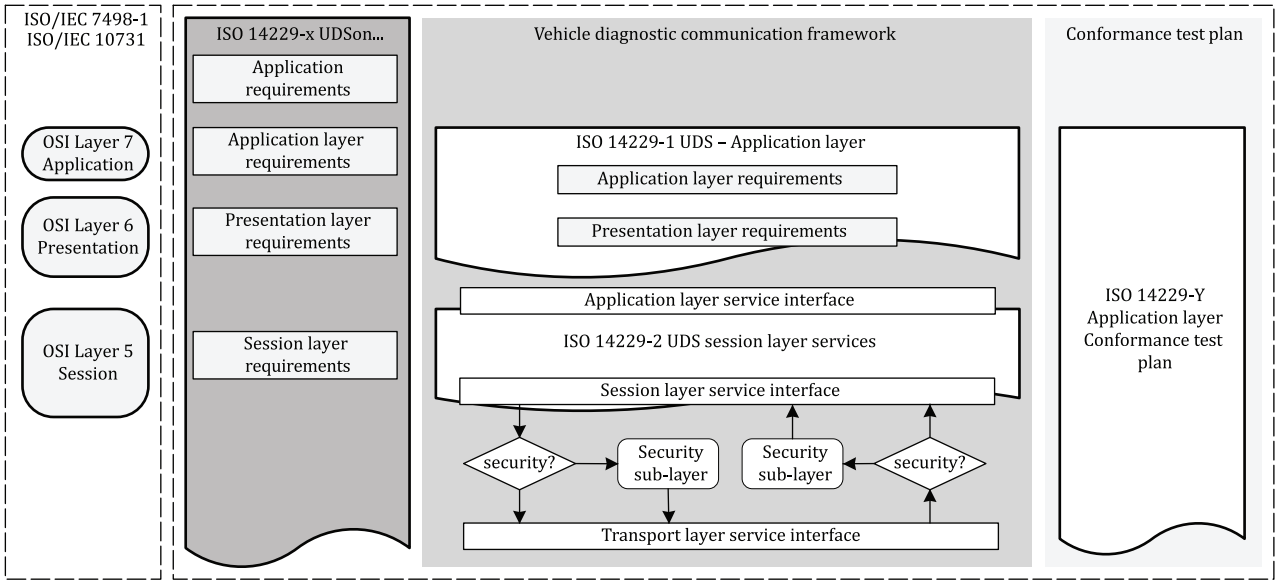

Figure 1 — ISO 14229 series reference according to OSI model

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Road vehicles — Unified diagnostic services (UDS) —

Part 2:
Session layer services

1 Scope

This document specifies common session layer services and requirements to provide independence between unified diagnostic services (ISO 14229-1) and all transport protocols and network layer services (e.g. ISO 13400-2 DoIP, ISO 15765-2 DoCAN, ISO 10681-2 communication on FlexRay, ISO 14230-2 DoK-Line, and ISO 20794-3 CXPI).

This document specifies a common service primitive interface between OSI layer 5 (session) and layer 4 (transport) via so-called service request/indication/confirmation primitives.

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 14229-1, *Road vehicles — Unified diagnostic services (UDS) — Part 1: Application layer*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14229-1, ISO/IEC 7498-1 and the following apply.

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

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

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

3.1
gateway
networking device that transfers the PDU on different OSI layers

EXAMPLE A network device that enables communication between control module networks that uses different communication protocols, different communication rates, etc. and that includes, but is not limited to, gateway functionalities like bridge, *switch* (3.3), *router* (3.2) or application layer routing.

3.2
router
networking device that transfers the PDU on OSI layers 3 and 4

3.3
switch
networking device that transfers the PDU on OSI layer 2

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4 Symbols and abbreviated terms

4.1 Symbols

—	empty cell/undefined
t	time

4.2 Abbreviated terms

Diag	diagnostics
ECU	electronic control unit
N/A	not applicable
OSI	open systems interconnection
RDiag	remote diagnostics
S_AE	session layer address extension
S_Data	session layer data transfer service name
S_Length	session layer length of data
S_Mtype	session layer message type
S_PDU	session layer protocol data unit
S_SA	session layer source address
S_TA	session layer target address
S_TAtype	session layer target address type
SecureDiag	secure diagnostics
SecureRDiag	secure remote diagnostics
SI	service identifier
SOM	start of message
SPP	service primitive parameter

5 Conventions

This document is based on the OSI service conventions as specified in ISO/IEC 10731[1].

Annex B describes vehicle diagnostic OSI layer architecture examples.

6 Session layer services

6.1 Service interface

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

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The service primitives define how a service user (e.g. diagnostic application) cooperates with a service provider (e.g. session layer). To define the services, three types of service primitives are specified:

— a service request primitive `S_Data.request`, used by the higher application layer to pass control information or data required to be transmitted to the session layer (i.e. the service provider is being requested by the service user to process control information or to transmit data);

— a service indication primitive `S_Data.indication`, used by the session layer to pass status information and received data to the higher application layer (i.e. the service user is being informed by the service provider about an internal event of the session layer or the service request of a peer protocol layer entity service user);

— a service confirmation primitive `S_Data.confirm` used by the session layer to pass status information to the application layer (i.e. the service user is being informed by service provider about the result of a preceding service request of the service user).

6.2 Service interface parameters

The session layer services have the same general format. Service primitives are written in the form:

```
service_name.type  (
                    parameter A,
                    parameter B,
                    parameter C,
                    [parameter X],
                    ...
                    )
```

where

— "service_name" is the name of the service (e.g. S_Data),

— "type" indicates the type of the service primitive (e.g. request, indication, confirm),

— "parameter A, ..." is the S_PDU (session layer protocol data unit) as a list of values passed by the service primitive (e.g. addressing information, data, length, result),

— "parameter A, parameter B, parameter C" are mandatory parameters that are included in all service calls, "[parameter X]" is an optional parameter that is included if specific conditions are fulfilled.

6.3 Service interface primitives

Figure 2 shows the session layer service primitives of a message transmission with a `T_Data.ind` reception at the session layer of the receiver side from the lower OSI layer.

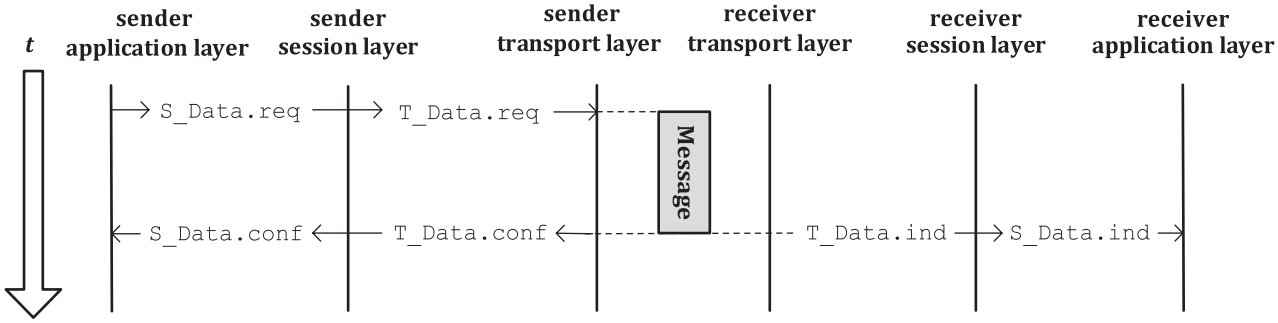

Figure 2 — Session layer service primitives – T_Data.ind message reception

Figure 3 shows the session layer service primitives of a message transmission with a `T_DataSOM.ind` reception at the beginning of the message and a `T_Data.ind` reception at the end of the message at the session layer of the receiver side from the lower OSI layer.

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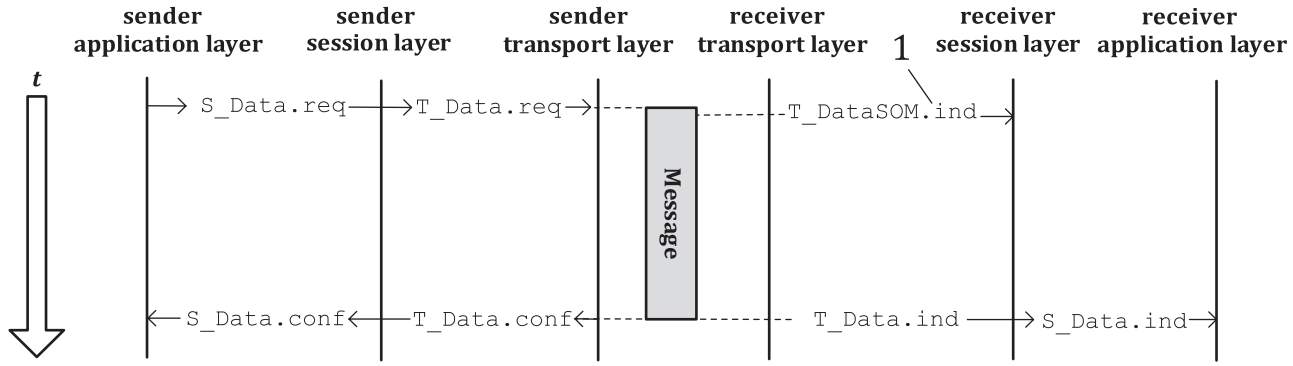

Key

1 transport layer StartOfMessage data indication, e.g. ISO 15765-2

Figure 3 — Session layer service primitives – T_DataSOM.ind and T_Data.ind reception

The following communication scenarios are distinguished:

a) physical communication during

   1) default session, and

   2) non-default session — session handling required;

b) functional communication during

   1) default session, and

   2) non-default session — session handling required.

7 Service interface (SI) definition from application layer to session layer

7.1 SI — S_Data.req, S_Data.ind, and S_Data.conf service interface

The service interface defines the service and parameter mapping from the application layer to the session layer.

Figure 4 shows the `S_Data.req`, `S_Data.ind`, and `S_Data.conf` service interface.

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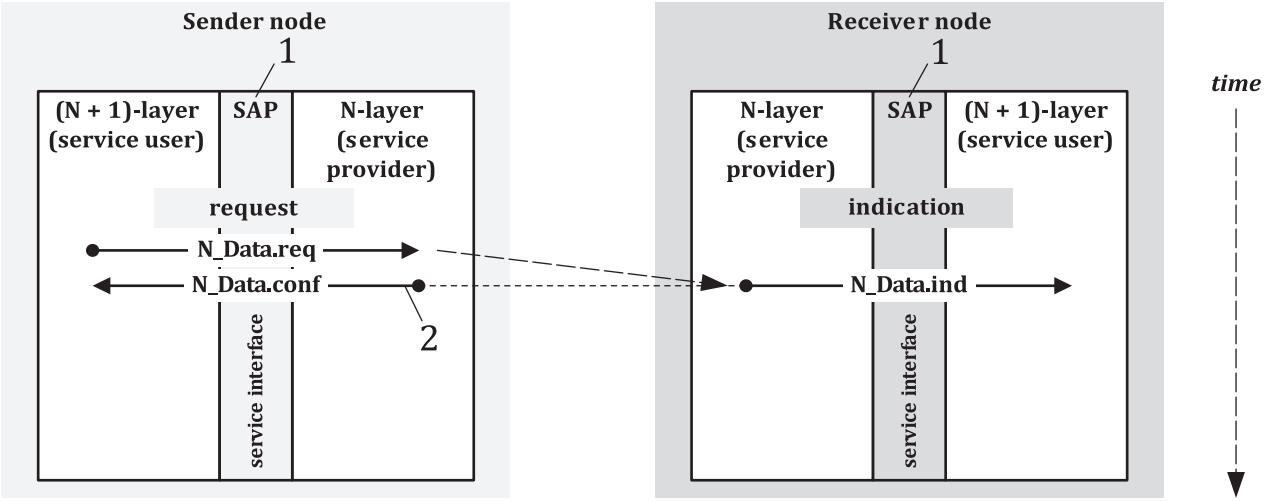

Key

1 service access point

2 read back from N-layer service provider

Figure 4 — S_Data.req and S_Data.ind service interface

7.2 SI — S_Data.req, S_Data.ind, and S_Data.conf service interface parameter mapping

This requirement specifies the application service interface and parameter mapping between the session layer and the lower OSI layers.

REQ	0.1 SI — S_Data.req, S_Data.ind, and S_Data.conf service interface parameter mapping
The `S_Data.req`, `S_Data.ind`, and `S_Data.conf` service interface parameter mapping shall be implemented as specified in Table 1.	

Table 1 — S_Data.req and S_Data.ind service interface parameter mapping

Application layer (service user)	Session layer (service provider)	A_Data.req, A_Data.ind and A_Data.conf parameter validity		
		.req	.ind	.conf
`A_Mtype`	`S_Mtype`	X	X	X
`A_AI[TAtype]`	`S_AI[TAtype]`	X	X	X
`A_AI[TA]`	`S_AI[TA]`	X	X	X
`A_AI[SA]`	`S_AI[SA]`	X	X	X
`A_AI[AE]`	`S_AI[AE]`	X	X	X
`A_Length`	`S_Length`	X	X	—
`A_Data`	`S_Data`	X	X	—
`A_Result`	`S_Result`	—	X	X

Key

X = supported

— = not supported

7.3 SI — S_PDU mapping onto T_PDU and vice versa for message transmission

The parameters of the session layer protocol data unit defined to request the transmission of a diagnostic service request/response are mapped onto the parameters of the transport layer protocol

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data unit for the transmission of a message in the client/server. Annex A specifies the T_PDU interface and shall be followed.

The parameters of the transport layer protocol data unit defined for the reception of a message are mapped as follows onto the parameters of the session layer protocol data unit for the confirmation/indication of the reception of a diagnostic response/request.

The transport layer confirmation of the successful transmission of the message (`T_Data.conf`) is forwarded to the application, because it is needed in the application for starting those actions, which shall be executed immediately after the transmission of the request/response message (e.g. ECUReset, bit rate change).

The transport layer indication for the reception of a StartOfMessage T_PDU (`T_DataSOM.ind`), e.g. ISO 15765-2 is not forwarded to the application layer, because it is only used within the session layer to perform the session layer timing (see Clause 9). Therefore, no mapping of the `T_DataSOM.ind` T_PDU onto an S_PDU is defined.

Table 2 defines the mapping of session layer S_PDU onto transport layer T_PDU and vice versa.

Table 2 — Mapping of session layer S_PDU onto transport layer T_PDU and vice versa

S_PDU parameter (session layer protocol data unit)	Description	T_PDU parameter (transport layer protocol data unit)	Description
`S_Mtype`	Session layer message type	`T_Ptype`	Transport layer segment type
`S_AI[TAtype]`	Session layer target address type	`T_AI[TAtype]`	Transport layer target address type
`S_AI[SA]`	Session layer source address	`T_AI[SA]`	Transport layer source address
`S_AI[TA]`	Session layer target address	`T_AI[TA]`	Transport layer target address
`S_AI[AE]`[a]	Session layer address extension	`T_AI[AE]`[a]	Transport layer address extension
`S_Data[1]` – `S_Data[n]`	Session layer data	`T_Data[1]` – `T_Data[n]`	Transport layer data
`S_Length`	Session layer data length	`T_Length`	Transport layer data length
`S_Result`	Session layer result	`T_Result`	Transport layer result

[a] If `Mtype` = diagnostics/secure diagnostics, then the address information shall consist of the parameters `SA`, `TA` and `TAtype`.

If `Mtype` = remote diagnostics/secure remote diagnostics, then the address information shall consist of the parameters `SA`, `TA`, `TAtype`, and `AE`.

7.4 SI — S_Data.req

The service primitive requests transmission of `S_Data` with `S_Length` number of bytes from the sender to the receiver peer entities identified by the address information in `S_AI[TAtype]`, `S_AI[SA]`, `S_AI[TA]`, and `S_AI[AE]`.

If the `S_Data.req` service is called, the session layer signals the completion (or failure) of the message transmission to the service user by means of the issuing of an `S_Data.conf` service call.

```
S_Data.req     (
               S_Mtype,
               S_AI[TAtype],
               S_AI[SA],
               S_AI[TA],
               [S_AI[AE]],
               S_Data[Data#1, Data#2, …, Data#n],
               S_Length
               )
```


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7.5 SI — S_Data.ind

The `S_Data.indication` service is issued by the session layer. The service primitive shall indicate `S_Result` events and delivers `S_Data` with `S_Length` bytes received from a peer protocol entity identified by the address information in `S_AI[TAtype]`, `S_AI[SA]`, `S_AI[TA]`, and `S_AI[AE]` to the adjacent upper layer. The parameters `S_Data` and `S_Length` shall only be valid if `S_Result` equals `S_OK`.

```
S_Data.ind     (
               S_Mtype,
               S_AI[TAtype],
               S_AI[SA],
               S_AI[TA],
               [S_AI[AE]],
               S_Data[Data#1, Data#2, …, Data#n],
               S_Length,
               S_Result
              )
```

7.6 SI — S_Data.conf

The `S_Data.conf` service is issued by the session layer. The service primitive confirms the completion of an `S_Data.req` service identified by the address information in `S_AI[TAtype]`, `S_AI[SA]`, `S_AI[TA]`, and `S_AI[AE]`. The parameter `S_Result` provides the status of the service request.

```
S_Data.conf    (
               S_Mtype,
               S_AI[TAtype],
               S_AI[SA],
               S_AI[TA],
               [S_AI[AE]],
               S_Result
               )
```

8 Service primitive parameters (SPP)

8.1 SPP – General

Clause 8 specifies the service primitive parameters and data types, which are used by the application layer services.

8.2 SPP – Data type definitions

REQ	0.2 SPP – 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, — `Unsigned Long` = 32-bit unsigned numeric value, — `Byte Array` = sequence of 8-bit aligned data, — `Bit String` = 8-bit binary coded.	

8.3 SPP – S_Mtype, session layer message type

The parameter `S_Mtype` is used to identify the type and range of address information parameters included in a service call. This document specifies a range of two values for this parameter.

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REQ	0.3 SPP – S_Mtype, session layer message type
The `S_Mtype` parameter shall be of data type `Enum` and shall be used to identify the message type and range of address information included in a service call. — If `S_Mtype` = diagnostics (`Diag`)/secure diagnostics (`SecureDiag`), then the address information shall consist of the parameters `S_SA`, `S_TA` and `S_TAtype`. — If `S_Mtype` = remote diagnostics (`RDiag`)/secure remote diagnostics (`SecureRDiag`), then the address information shall consist of the parameters `S_SA`, `S_TA`, `S_TAtype` and `S_AE`. Range: [`Diag, RDiag, SecureDiag, SecureRDiag`]	

8.4 SPP – S_TAtype, session layer target address type

The parameter `S_TAtype` is a configuration attribute to the `S_TA` parameter. It is used to encode the communication model used by the communicating peer entities. Two communication models are specified: '1 to 1' communication, called physical addressing, and '1 to n' communication, called functional addressing.

REQ	0.4 SPP – S_TAtype, session layer target address type
The `S_TAtype` parameter shall be of data type `Enum` and shall be used to identify the target address type to be used with the request address. Range: [`physical, functional`]	

8.5 SPP – S_TA, session layer target address

`S_TA` parameter is used to encode the receiving session layer protocol entity. The parameter `S_TA` is used to encode client and server identifiers.

REQ	0.5 SPP – S_TA, session layer target address
The `S_TA` parameter shall be of data type `Unsigned Word` and shall contain the target address of the node. Range: [0000_{16} to $FFFF_{16}$]	

8.6 SPP – S_SA, session layer source address

`S_SA` parameter is used to encode the sending session layer protocol entity. The parameter `S_SA` is used to encode client and server identifiers.

REQ	0.6 SPP – S_SA, session layer source address
The `S_SA` parameter shall be of data type `Unsigned Word` and shall contain the source address of the node. Range: [0000_{16} to $FFFF_{16}$]	

8.7 SPP – S_AE, session layer address extension

`S_AE` parameter is used to encode the sending session layer protocol entity. The parameter `S_AE` is used to encode client and server identifiers.

REQ	0.7 SPP – S_AE, session layer address extension
The `S_AE` parameter shall be of data type `Unsigned Word` and shall contain the extended address of the node. Range: [0000_{16} to $FFFF_{16}$]	

8.8 SPP – S_Length, session layer length of S_Data

This parameter includes the length of data to be transmitted/received.

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REQ	0.8 SPP – S_Length, session layer length of S_Data
The `S_Length` parameter shall be of data type `Unsigned Long` and shall contain the length of the `S_Data` to be transmitted/received. Range: [$0000\ 0000_{16}$ to $FFFF\ FFFF_{16}$]	

8.9 SPP – S_Data, session layer data of PDU

This parameter includes data to be exchanged by the higher OSI layer entities.

REQ	0.9 SPP – S_Data, session layer data of PDU
The `S_Data` parameter shall be of data type `Byte Array` and shall contain the message data content of the request or response message to be transmitted/received. Range: [00_{16} to FF_{16}]	

8.10 SPP – S_Result, session layer result

This parameter contains the status related to the outcome of a service execution.

REQ	0.10 SPP – S_Result, session layer result
The `S_Result` parameter shall be of data type `Enum` and shall contain the status relating to the outcome of a service execution (request field and response field sequence). If two or more errors are discovered at the same time, then the application layer entity shall set the appropriate error bit in the `Result` parameter. Range: [`OK, ERR_...`] The result `OK` shall be issued to the service user when the service execution is successfully completed. The `OK` shall be issued to a service user on both, the sender and receiver side. The `ERR_...` shall be issued to the service user when an error is detected by a lower layer (provider). The `ERR_...` shall be issued to the service user on both, the sender and receiver side.	

9 Timing parameter definition

9.1 General application timing considerations

9.1.1 Server

REQ	5.1 Timing parameter definition – Server – t_{P2_Server}
A server shall use a single application timer (t_{P2_Server}) implementation, which is triggered (started and stopped) by the T_Data service primitive interface (`T_Data.req, T_Data.conf, T_DataSOM.ind, T_Data.ind`).	

REQ	5.2 Timing parameter definition – Server – $t_{P2_Server_Max}$/$t_{P2*_Server_Max}$
The t_{P2_Server} application timer shall be loaded with a $t_{P2_Server_Max}$/$t_{P2*_Server_Max}$ parameter value. Both parameters and values are specified in Table 3 and in Table 4.	

REQ	5.3 Timing parameter definition – Server – t_{P4_Server}
The parameter t_{P4_Server} is a performance requirement and shall be the time between the reception of a request (`T_Data.ind`) and the start of transmission of the final response (`T_Data.req`).	

The timing parameter t_{P4} is a performance parameter.

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REQ	5.4 Timing parameter definition – Server – $t_{P4_Server_Max}$
The parameter $t_{P4_Server_Max}$ shall be the maximum value of t_{P4_Server} and if $t_{P4_Server_Max}$ is the same as $t_{P2_Server_Max}$, this shall be interpreted as that a negative response with negative response code 78_{16} "requestCorrectlyReceived-ResponsePending" is not allowed for the service in progress.	

REQ	5.5 Timing parameter definition – Server – Final response
A final response shall be a positive response or a negative response with a negative response code other than 78^{16} "requestCorrectlyReceived-ResponsePending".	

In case of a request to schedule periodic responses, the initial USDT positive or negative response that indicates the acceptance or non-acceptance of the request to schedule periodic responses is considered the final response.

REQ	5.6 Timing parameter definition – Server – Service not supported
Services not supported by the server shall utilize a $t_{P4_Server_Max}$ value equal to $t_{P2_Server_Max}$. A negative response with a negative response code 78_{16} "requestCorrectlyReceived-ResponsePending" shall not be allowed.	

9.1.2 Client

REQ	5.7 Timing parameter definition – Client – t_{P_Client}
A client shall use a single application timer (t_{P_Client}) implementation which is triggered (started, reloaded, and stopped) by the `T_Data` service primitive interface (`T_Data.req`, `T_Data.conf`, `T_DataSOM.ind`, `T_Data.ind`).	

REQ	5.8 Timing parameter definition – Client – $t_{P2_Client_Max}$/$t_{P2*_Client_Max}$
The t_{P_Client} application timer shall be loaded with a $t_{P2_Client_Max}$/$t_{P2*_Client_Max}$ for protocols, which support a `T_DataSOM.ind` service primitive (e.g. ISO 15765 DoCAN).	

REQ	5.9 Timing parameter definition – Client – t_{P_Client} start
The t_{P_Client} application timer shall be started, whenever the client application layer receives a `T_Data.conf` service primitive. Depending on the protocol type (with `T_DataSOM.ind` or without `T_DataSOM.ind`) the t_{P_Client} application timer shall be loaded with a $t_{P2_Client_Max}$ or a $t_{P6_Client_Max}$ parameter value.	

REQ	5.10 Timing parameter definition – Client – t_{P_Client} stop
Depending on the protocol type (with `T_DataSOM.ind` or without `T_DataSOM.ind`) the t_{P_Client} application timer shall be stopped, either when the `T_DataSOM.ind` or the `T_Data.ind` service primitive is received by the application.	

REQ	5.11 Timing parameter definition – Client – $t_{P6_Client_Max}$/$t_{P6*_Client_Max}$
The t_{P_Client} application timer shall be loaded with a $t_{P6_Client_Max}$/$t_{P6*_Client_Max}$ for protocols, which do not support a `T_DataSOM.ind` service primitive (e.g. ISO 13400 DoIP).	

REQ	5.12 Timing parameter definition – Client – Error condition detection
If no `".ind"` is received while t_{P_Client} is smaller or equal to $t_{P2_Client_Max}$ an error condition shall be detected.	

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REQ	5.13 Timing parameter definition – Client – Error indication to application layer
The error condition shall be flagged to the application layer with the parameters included in either `T_DataSOM.ind` or the `T_Data.ind` service primitive.	

REQ	5.14 Timing parameter definition – Client – Application layer protocols with support of `T_DataSOM.ind`
For application layer protocols, which support `T_DataSOM.ind`, the client application shall verify the correct application timing by comparing its actual t_{P_Client} application timer value with the $t_{P2_Client_Max}$ parameter value.	

If `T_DataSOM.ind` or `T_Data.ind` is received while t_{P_Client} is smaller or equal to $t_{P2_Client_Max}$ the timing fulfils the requirements established by this document.

REQ	5.15 Timing parameter definition – Client – Application layer protocols with no support of `T_DataSOM.ind`
For application layer protocols, which only support `T_Data.ind`, the client application shall verify the correct application timing by comparing its actual t_{P_Client} application timer value with the $t_{P6_Client_Max}$ parameter value.	

If `T_Data.ind` is received while t_{P_Client} is smaller or equal to $t_{P6_Client_Max}$ the timing fulfils the requirements established by this document.

REQ	5.16 Timing parameter definition – Client – Error condition detection and reporting
If no indication (`.ind`) is received while t_{P_Client} is smaller or equal to $t_{P6_Client_Max}$ an error condition shall be detected and shall be flagged to the application layer with the parameters included in the `T_Data.ind` service primitive.	

9.2 Application timing parameter definitions – defaultSession

REQ	5.17 Timing parameter definition – defaultSession start
A server shall start the defaultSession when powered up.	

REQ	5.18 Timing parameter definition – Timing parameter definition of defaultSession
The timing parameter definitions shall be in accordance with Table 3.	

Table 3 — Message timing parameter definitions for the defaultSession

Timing parameter	Definition	Type
Δt_{P2}	The Δt_{P2} parameter is defined to be the worst-case vehicle network design-dependent message transmission delay such as delays introduced by gateways and bus-load dependent arbitration. The value of Δt_{P2} is divided into the time to transmit the request to the addressed server/ECU ($\Delta t_{P2_Request}$) and in case the protocol supports `T_DataSOM.ind` till the start of the response transmission indicated by `T_DataSOM.ind` or `T_Data.ind` if the response is a single frame message (e.g. ISO 15765 DoCAN).	Performance requirement

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