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Road vehicles— Unified diagnostic services (UDS) —

Part 2: Session layer services

Véhicules routiers — Services de diagnostic unifiés (SDU) —

Partie 2: Séquence des couches de services

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Foreword

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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.

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ISO 14229-2 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

ISO 14229 consists of the following parts, under the general title *Road vehicles — Unified diagnostic services (UDS)*:

— *Part 1: Specification and requirements*

— *Part 2: Session layer services*

— *Part 3: Unified diagnostic services on CAN implementation (UDSonCAN)*

— *Part 4: Unified diagnostic services on FlexRay implementation (UDSonFR)*

— *Part 5: Unified diagnostic services on Internet Protocol implementation (UDSonIP)*

— *Part 6: Unified diagnostic services on K-Line implementation (UDSonK-Line)*

The following part is under preparation:

— *Part 7: Unified diagnostic services on Local Interconnect Network implementation (UDSonLIN)*

The titles of future parts will be drafted as follows:

— *Part n: Unified diagnostic services on … implementation (UDSon…)*

Introduction

ISO 14229 has been established in order to define common requirements for diagnostic systems that are independent of the underlying serial data link.

To achieve this, ISO 14229 is based on the Open Systems Interconnection (OSI) Basic Reference Model in accordance with ISO 7498-1 and ISO/IEC 10731, 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 broken into the following layers in accordance with Table 1:

— Application layer (layer 7), unified diagnostic services specified in ISO 14229-1, ISO 14229-3 UDSonCAN, ISO 14229-4 UDSonFR, ISO 14229-5 UDSonIP, ISO 14229-6 UDSonK-Line, ISO 14229-7 UDSonLIN, further standards and ISO 27145-3 WWH-OBD.

— Presentation layer (layer 6), vehicle manufacturer specific, ISO 27145-2 WWH-OBD.

— Session layer services (layer 5) specified in this part of ISO 14229.

— Transport layer services (layer 4), specified in ISO 15765-2 DoCAN, ISO 10681-2 Communication on FlexRay, ISO 13400-2 DoIP, ISO 27145-4 WWH-OBD.

— Network layer services (layer 3), specified in ISO 15765-2 DoCAN, ISO 10681-2 Communication on FlexRay, ISO 13400-2 DoIP, ISO 27145-4 WWH-OBD.

— Data link layer (layer 2), specified in ISO 11898-1, ISO 11898-2, ISO 17458-2, ISO 13400-3, IEEE 802.3, ISO 14230-2 and further standards, ISO 27145-4 WWH-OBD.

— Physical layer (layer 1), specified in ISO 11898-1, ISO 11898-2, ISO 17458-4, ISO 13400-3, IEEE 802.3, ISO 14230-1, further standards, ISO 27145-4 WWH-OBD.

Table 1 — Example of diagnostic/programming specifications applicable to the OSI layers

<table>
<tr><th>Applicability</th><th>OSI seven layer</th><th colspan="5">Enhanced diagnostics services</th><th>WWH-OBD</th></tr>
<tr><td rowspan="9">Seven layer according to ISO/IEC 7498-1 and ISO/IEC 10731</td><td>Application (layer 7)</td><td colspan="5">ISO 14229-1, ISO 14229-3 UDSonCAN, ISO 14229-4 UDSonFR, ISO 14229-5 UDSonIP, ISO 14229-6 UDSonK-Line, ISO 14229-7 UDSonLIN, further standards</td><td>ISO 27145-3</td></tr>
<tr><td>Presentation (layer 6)</td><td colspan="5">vehicle manufacturer specific</td><td>ISO 27145-2</td></tr>
<tr><td>Session (layer 5)</td><td colspan="6">ISO 14229-2</td></tr>
<tr><td>Transport (layer 4)</td><td rowspan="2">ISO 15765-2</td><td rowspan="2">ISO 10681-2</td><td rowspan="2">ISO 13400-2</td><td rowspan="2">Not applicable</td><td>further standards</td><td rowspan="4">ISO 27145-4</td></tr>
<tr><td>Network (layer 3)</td><td>further standards</td></tr>
<tr><td>Data link (layer 2)</td><td rowspan="2">ISO 11898-1, ISO 11898-2</td><td>ISO 17458-2</td><td rowspan="2">ISO 13400-3, IEEE 802.3</td><td>ISO 14230-2</td><td>further standards</td></tr>
<tr><td>Physical (layer 1)</td><td>ISO 17458-4</td><td>ISO 14230-1</td><td>further standards</td></tr>
</table>

Road vehicles — Unified diagnostic services (UDS) — Part 2: Session layer services

1 Scope

This part of ISO 14229 specifies data link independent requirements of session layer services.

This part of ISO 14229 specifies common session layer services to provide independence between unified diagnostic services (ISO 14229-1) and all transport protocols and network layer services (e.g. ISO 15765-2 DoCAN, ISO 10681-2 Communication on FlexRay, ISO 13400 DoIP, ISO 14230-2 DoK-Line, etc.)

This part of ISO 14229 specifies a common service primitive interface between OSI layer 4 (Transport) and layer 5 (Session) via so-called service request/confirmation/indication primitives. This interface allows seamless implementation of ISO 14229-1 Unified diagnostic services (UDS) with any communication protocol titled "DoXYZ / CoXYZ" like ISO 15765 DoCAN – Diagnostic communication over Controller Area Network, ISO 13400 DoIP, ISO 10681 Communication over FlexRay, ISO 14230 DoK-Line.

ISO 15031 (emissions-related OBD) and ISO 27145 (WWH-OBD) support the standardized service primitive interface.

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 14229-1, *Road vehicles — Unified diagnostic services (UDS) — Part 1: Specification and requirements*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

3.1.1
gateway
networking device that transfers the PDU on different OSI layers

EXAMPLE A network device that enables communication between control module networks that use different communication protocols, different communication rates, etc. That includes, but is not limited to, gateway functionalities like bridge, switch, router or application layer routing.

3.1.2
router
networking device that transfers the PDU on OSI layers 3 and 4

3.1.3
switch
networking device that transfers the PDU on OSI layer 2

3.2 Abbreviated terms

CDD	common data dictionary
CMD	common message dictionary
DSC	diagnostic session control
ECU	electronic control unit
OSI	open systems interconnection
S_AE	session layer address extension
S_SA	session layer source address
S_Data	session layer data transfer service name
SI	service identifier
SOM	start of message
S_Mtype	session layer message type
S_PDU	session layer protocol data unit
S_TA	session layer target address
S_TAtype	session layer target address type

4 Conventions

This part of ISO 14229 is guided by the conventions discussed in the OSI Service Conventions (ISO 10731:1994) as they apply to the diagnostic services. These conventions specify the interactions between the service user and the service provider. Information is passed between the service user and the service provider by service primitives, which may convey parameters.

5 Document overview

Figure 1 illustrates implementations of ISO 14229-2 onto various protocols.

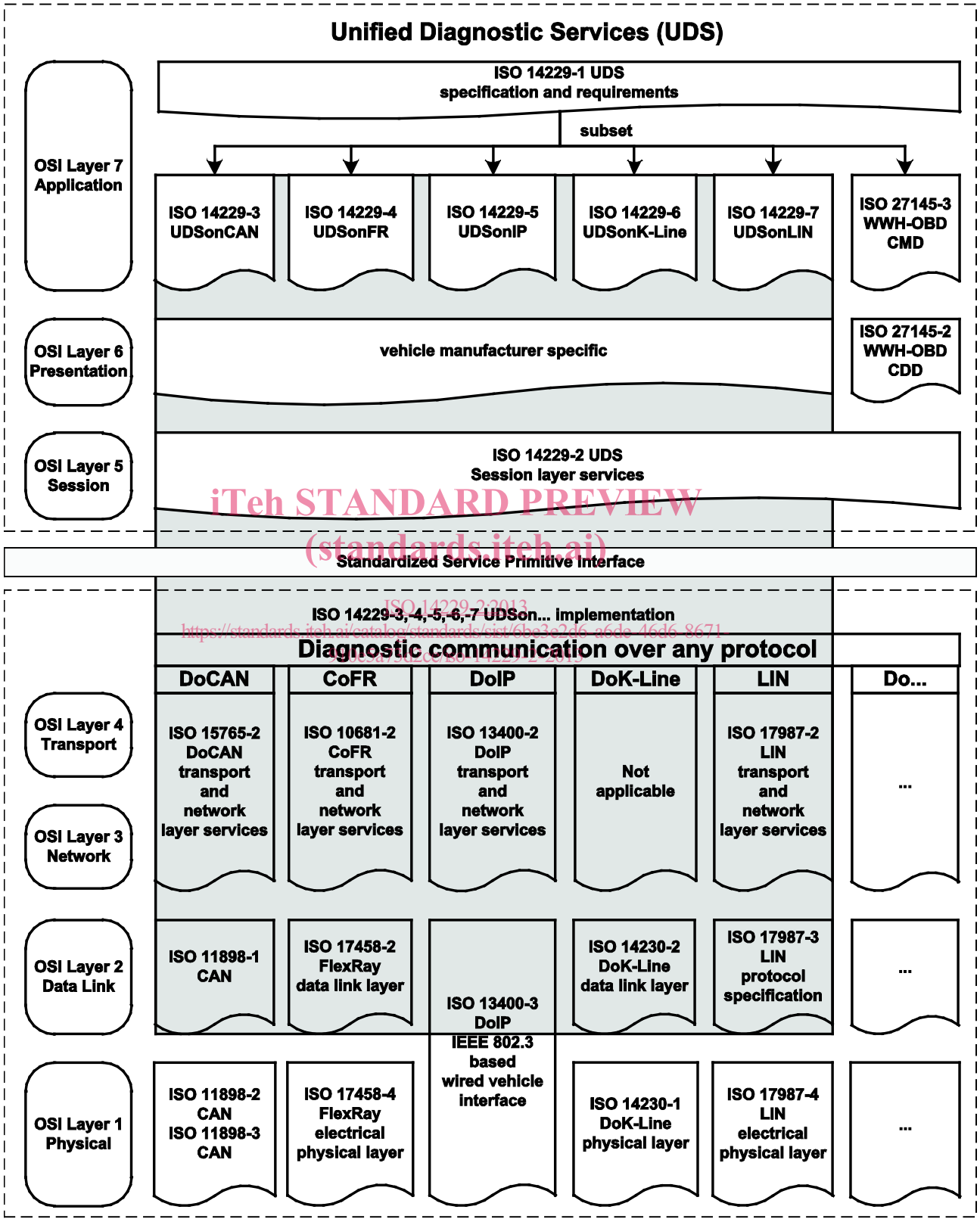


Figure 1 — Implementation of UDS document reference according to OSI model

6 Session layer services

6.1 General

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.

All session layer services have the same general structure. 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);

All 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 shall be included in all service calls,

— "[parameter X]" is an optional parameter that is included if specific conditions are fulfilled.

Figure 2 shows the session layer service primitives for a single frame message.

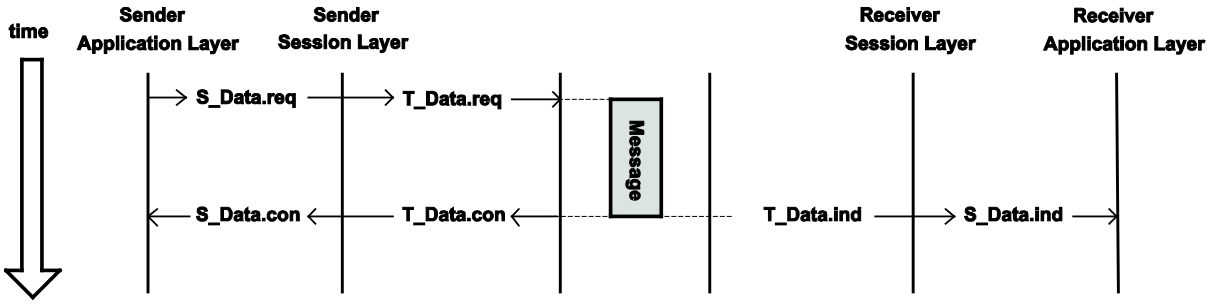
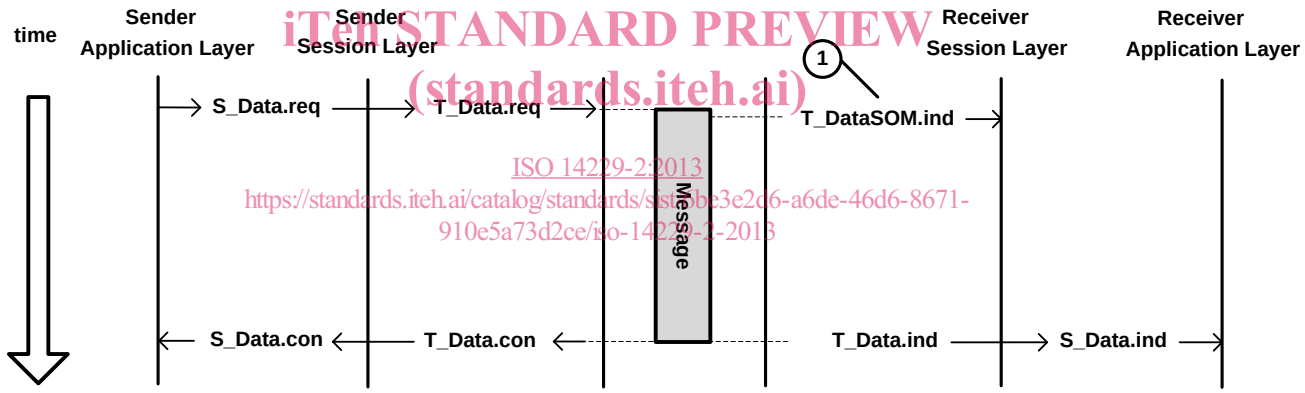


Figure 2 — Session layer service primitives – Single frame message

Figure 3 shows the session layer service primitives for a multiple frame message, if the transport/network layer supports the T_DataSOM.ind interfaces.



Key

1 optional, i.e. the transport/network layer supports the T_DataSOM.ind interfaces

Figure 3 — Session layer service primitives – Multiple frame message

The following communication scenarios shall be 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.

For all cases, the possibility of requesting an enhanced response-timing window by the server via a negative response message, including a negative response code 0x78, shall be considered. The transport/network layer services as defined in different ISO standards (e.g. ISO 15765-2 DoCAN or ISO 10681-2 CoFR) are used to perform the diagnostic session management timing in the client and the server.

6.2 Specification of session layer service primitives

6.2.1 General

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

6.2.2 S_Data.request

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_SA, S_TA, S_TAtype, and S_AE. Each time the S_Data.request service is called, the session layer shall signal the completion (or failure) of the message transmission to the service user by means of the issuing of an S_Data.confirm service call.

```
S_Data.request      (
                     S_Mtype,
                     S_SA,
                     S_TA,
                     S_TAtype,
                     [S_AE],
                     S_Data [Data#1, Data#2, …, Data#n ],
                     S_Length
                    )
```


6.2.3 S_Data.confirm

The S_Data.confirm service is issued by the session layer. The service primitive confirms the completion of an S_Data.request service identified by the address information in S_SA, S_TA, S_TAtype, and S_AE. The parameter S_Result provides the status of the service request.

```
S_Data.confirm      (
                     S_Mtype,
                     S_SA,
                     S_TA,
                     S_TAtype,
                     [S_AE],
                     S_Result
                    )
```

6.2.4 S_Data.indication

The S_Data.indication service is issued by the session layer. The service primitive indicates S_Result events and delivers S_Data with S_Length bytes received from a peer protocol entity identified by the address information in S_SA, S_TA, S_TAtype to the adjacent upper layer.

The parameters S_Data and S_Length are only valid if S_Result equals S_OK.

```
S_Data.indication   (
                     S_Mtype,
                     S_SA,
                     S_TA,
                     S_TAtype,
                     [S_AE],
                      S_Data [Data#1, Data#2, …, Data#n],
                     S_Length,
                     S_Result
                    )
```

6.3 Session data unit specification

6.3.1 S_Mtype, Session layer message type

Type: enumeration

Range: diagnostics, remote diagnostics

Description:

The parameter Mtype shall be used to identify the type and range of address information parameters included in a service call. This part of ISO 14229 specifies a range of two values for this parameter. The intention is that users of the document can extend the range of values by specifying other types and combinations of address information parameters to be used with the transport/network layer protocol specified in this document. For each such new range of address information, a new value for the Mtype parameter shall be specified to identify the new address information.

— If S_Mtype = diagnostics, then the address information shall consist of the parameters S_SA, S_TA, and S_TAtype.

— If S_Mtype = remote diagnostics, then the address information shall consist of the parameters S_SA, S_TA, S_TAtype, and S_AE.

6.3.2 S_SA, Session layer source address

Type: 2 byte unsigned integer value

Range: 0x0000 – 0xFFFF

Description:

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

6.3.3 S_TA, Session layer target address

Type: 2 byte unsigned integer value

Range: 0x0000 – 0xFFFF

Description:

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

6.3.4 S_TAtype, Session layer target address type

Type: enumeration

Range: physical, functional

Description:

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

— Physical addressing (1-to-1 communication) shall be supported for all types of session layer messages.

— Functional addressing (1-to-n communication) shall be supported. The transport/network layer requirements may restrict the usage of functional addressing (e.g. SingleFrame on CAN data link layer).

6.3.5 S_AE, Session layer Address Extension (optional parameter)

Type: 2 byte unsigned integer value

Range: 0x0000 - 0xFFFF

Description:

The S_AE parameter is used to extend the available address range for large networks, and to encode both sending and receiving transport/network layer entities of subnets other than the local network where the communication takes place. S_AE is only part of the addressing information if Mtype is set to remote diagnostics.

6.3.6 S_Length

Type: 4 Byte

Range: 0x0000 0000 – 0xFFFF FFFF

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

6.3.7 S_Data

Type: string of bytes

Range: not applicable

Description: This parameter includes all data to be exchanged by the higher layer entities.

6.3.8 S_Result

Type: enumeration

Range: S_OK, S_NOK

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

6.3.9 Mapping of S_PDU 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 as follows onto the parameters of the transport/network layer protocol data unit for the transmission of a message in the client/server.

The parameters of the transport/network 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 indication of the reception of a diagnostic response/request.

The transport/network layer confirmation of the successful transmission of the message (T_Data.con) 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, BaudrateChange, etc.).

The transport/network layer indication for the reception of a StartOfMessage T_PDU (T_DataSOM.ind) is not forwarded to the application layer, because it is only used within the session layer to perform the session layer timing (see clause 7). 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/Network layer T_PDU and vice versa.

Table 2 — Mapping of Session layer S_PDU onto Transport/Network layer T_PDU and vice versa

S_PDU parameter (Session layer Protocol Data Unit)	Description	T_PDU parameter (Transport/Network layer Protocol Data Unit)	Description
S_Mtype	Session layer Message type	T_Mtype	Transport/Network layer Message type
S_SA	Session layer Source Address	T_SA	Transport/Network layer Source Address
S_TA	Session layer Target Address	T_TA	Transport/Network layer Target Address
S_TAtype	Session layer Target Address type	T_TAtype	Transport/Network layer Target Address type
S_AE [a]	Session layer Address Extension	T_AE[a]	Transport/Network layer Address Extension
S_Data[1] – S_Data[n]	Session layer Data	T_Data[1] – T_Data[n]	Transport/Network layer Application Data
S_Length	Session layer Data Length	T_Length	Transport/Network layer Data Length
S_Result	Session layer Result	T_Result	Transport/Network layer Result

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

7 Timing parameter definition

7.1 General application timing considerations

7.1.1 Server

A server uses a single application timer ($P2_{Server}$) implementation which is triggered (started and stopped) by the T_Data service primitive interface (T_Data.ind, T_Data.con, T_Data.req).