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Road vehicles — Unified diagnostic services (UDS) —

Part 1: Specification and requirements

Véhicules routiers — Services de diagnostic unifiés (SDU) — Partie 1: Spécification et exigences

Reference number
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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.

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 14229-1 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

This first edition of ISO 14229-1 cancels and replaces ISO 14229:1998, which has been technically revised.

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

— *Part 1: Specification and requirements*

The following part is under preparation:

— *Part 2: Session layer services*

This corrected version of ISO 14229-1:2006 incorporates the following corrections:

— the document reference number, title and edition have been changed from “ISO 14229:2006, *Road vehicles — Unified diagnostic services (UDS) — Specification and requirements*, Second edition” to “ISO 14229-1:2006, *Road vehicles — Unified diagnostic services (UDS) — Part 1: Specification and requirements*, First edition” throughout the document;

— mention of "Part 2: Lager services" has been added to the Foreword.

Introduction

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

To achieve this, it 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:

— unified diagnostic services (layer 7); and

— communication services (layers 1 to 6).

NOTE The diagnostic services in this part of ISO 14229 are implemented in various applications, e.g. ISO 16844 (all parts), ISO 11992 (all parts), ISO 9141 (all parts), ISO 14230 (all parts), etc. Future modifications to this part of ISO 14229 will provide long-term backward compatibility with the implementation standards as described above.

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

Applicability	OSI layer	Enhanced diagnostics services (non-emissions-related)	
Seven layers according to ISO/IEC 7498-1 and ISO/IEC 10731	Application (layer 7)	ISO 14229-1/ISO 15765-3/ISO 11992-4	ISO 14229-1/further standards
	Presentation (layer 6)	—	—
	Session (layer 5)	ISO 15765-3/ISO 11992-4	further standards
	Transport (layer 4)	ISO 15765-2/ISO 11992-4	further standards
	Network (layer 3)	ISO 15765-2/ISO 11992-4	further standards
	Data link (layer 2)	ISO 11898/ISO 11992-1/SAE J1939-15	further standards
	Physical (layer 1)	ISO 11898/ISO 11992-1/SAE J1939-15	further standards

Figure 1 shows an example of the possible future implementation of this part of ISO 14229 onto various data links.

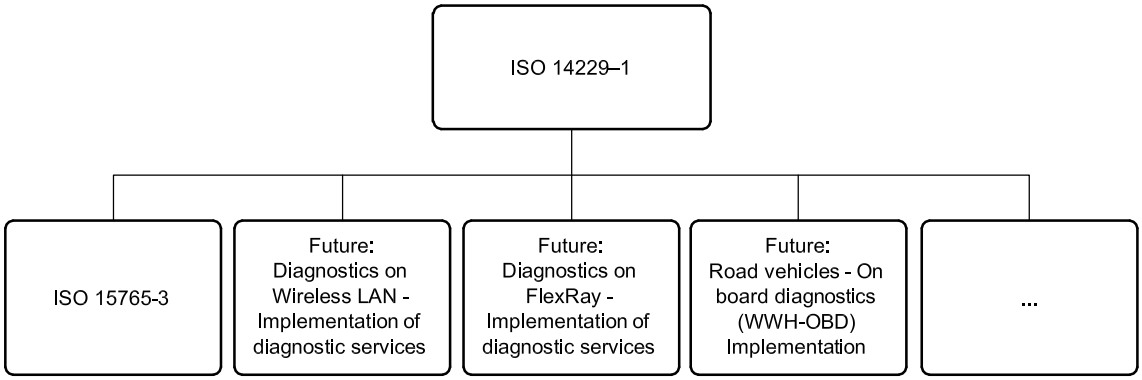

Figure 1 — Available International Standards and possible future implementations of this part of ISO 14229

Road vehicles — Unified diagnostic services (UDS) — Specification and requirements

Part 1: Specification and requirements

1 Scope

This part of ISO 14229 specifies data link independent requirements of diagnostic services, which allow a diagnostic tester (client) to control diagnostic functions in an on-vehicle Electronic Control Unit (server) such as an electronic fuel injection, automatic gear box, anti-lock braking system, etc. connected on a serial data link embedded in a road vehicle. It specifies generic services which allow the diagnostic tester (client) to stop or to resume non-diagnostic message transmission on the data link. This part of ISO 14229 does not apply to non-diagnostic message transmission or to use of the communication data link between two Electronic Control Units. It does not specify any implementation requirements.

The vehicle diagnostic architecture of this part of ISO 14229 applies to:

— a single tester (client) that may be temporarily or permanently connected to the on-vehicle diagnostic data link; and

— several on-vehicle Electronic Control Units (servers) connected directly or indirectly.

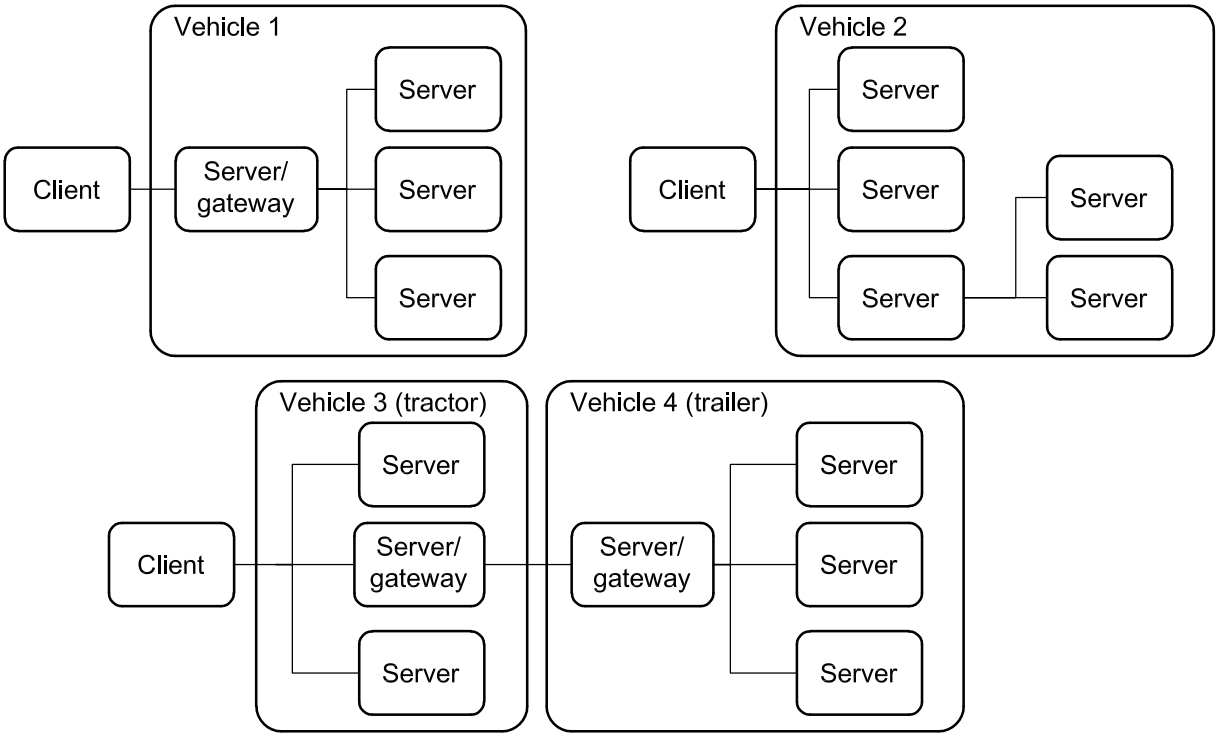

Figure 2 — Vehicle diagnostic architecture

In Figure 2:

— For vehicle 1, the servers are connected over an internal data link and indirectly connected to the diagnostic data link through a gateway. This part of ISO 14229 applies to the diagnostic communications over the diagnostic data link; the diagnostic communications over the internal data link may conform to this part of ISO 14229 or to another protocol.

— For vehicle 2, the servers are directly connected to the diagnostic data link.

— For vehicle 3, the servers are directly connected to the diagnostic data link through a gateway (same as vehicle 2) and vehicle 4 connects its server/gateway directly to the vehicle 3 server/gateway.

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 7498-1, *Information technology — Open Systems Interconnection — Basic Reference Model: The Basic Model*

ISO/IEC 10731, *Information technology — Open Systems Interconnection — Basic Reference Model — Conventions for the definition of OSI services*

ISO 11898 (all parts), *Road vehicles — Controller area network (CAN)*

ISO 11992-1, *Road vehicles — Interchange of digital information on electrical connections between towing and towed vehicles — Part 1: Physical and data-link layers*

ISO 11992-4, *Road vehicles — Interchange of digital information on electrical connections between towing and towed vehicles — Part 4: Diagnostics*

ISO 14230 (all parts), *Road vehicles — Diagnostic systems — Keyword Protocol 2000*

ISO 15765-2, *Road vehicles — Diagnostics on Controller Area Networks (CAN) — Part 2: Network layer services*

ISO 15765-3, *Road vehicles — Diagnostics on Controller Area Networks (CAN) — Part 3: Implementation of unified diagnostic services (UDS on CAN)*

ISO/TR 15031-2, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 2: Terms, definitions, abbreviations and acronyms*

ISO 15031-5, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 5: Emissions-related diagnostic services*

ISO 15031-6, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 6: Diagnostic trouble code definitions*

ISO 15031-7, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 7: Data link security*

ISO 15764, *Road vehicles — Extended data link security*

3 Terms and definitions

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

3.1
integer type
simple type with distinguished values which are the positive and the negative whole numbers

NOTE The range of integer type is not specified within this document.

3.2
diagnostic trouble code
numerical common identifier for a fault condition identified by the on-board diagnostic system

3.3
diagnostic service
information exchange initiated by a client in order to require diagnostic information from a server and/or to modify its behaviour for diagnostic purposes

3.4
client
function that is part of the tester and that makes use of the diagnostic services

NOTE A tester normally makes use of other functions such as database management, specific interpretation, human-machine interface.

3.5
server
function that is part of an electronic control unit and that provides the diagnostic services

NOTE This part of ISO 14229 differentiates between the server (i.e. the function) and the electronic control unit so that it remains independent from the implementation.

3.6
tester
system that controls functions such as test, inspection, monitoring or diagnosis of an on-vehicle electronic control unit and which may be dedicated to a specific type of operator (e.g. a scan tool dedicated to garage mechanics or a test tool dedicated to assembly plant agents)

NOTE The tester is also referenced as the client.

3.7
diagnostic data
data that is located in the memory of an electronic control unit which may be inspected and/or possibly modified by the tester (diagnostic data includes analogue inputs and outputs, digital inputs and outputs, intermediate values and various status information)

EXAMPLES Examples of diagnostic data include vehicle speed, throttle angle, mirror position, system status, etc. Three types of values are defined for diagnostic data:

— the current value: the value currently used by (or resulting from) the normal operation of the electronic control unit;

— a stored value: an internal copy of the current value made at specific moments, e.g. when a malfunction occurs or periodically (this copy is made under the control of the electronic control unit);

— a static value: e.g. VIN; the server is not obliged to keep internal copies of its data for diagnostic purposes, in which case the tester may only request the current value.

3.8
diagnostic session
current mode of the server, which affects the level of diagnostic functionality

NOTE Defining a repair shop or development testing session selects different server functionality (e.g. access to all memory locations may only be allowed in the development testing session).

3.9
diagnostic routine
routine that is embedded in an electronic control unit and that may be started by a server upon a request from the client

NOTE It could either run instead of a normal operating program or run concurrently to the normal operating program. In the first case, normal operation of the ECU is not possible. In the second case, multiple diagnostic routines may be enabled that run while all other parts of the electronic control unit are functioning normally.

3.10
record
one or more diagnostic data elements that are referred to together by a single means of identification

NOTE A snapshot including various input/output data and trouble codes is an example of a record.

3.11
security
as used in this part of ISO 14229, security access method that satisfies the requirements for tamper protection as specified in ISO 15031-7

3.12
functional unit
set of functionally close or complementary diagnostic services

3.13
local server
server that is connected to the same local network as the client and is part of the same address space as the client

3.14
local client
client that is connected to the same local network as the server and is part of the same address space as the server

3.15
remote server
server that is not directly connected to the main diagnostic network

NOTE 1 A remote server is identified by means of a remote network address. Remote network addresses represent an own network address space that is independent from the addresses on the main network.

NOTE 2 A remote server is reached via a local server on the main network. Each local server on the main network can act as a gate to one independent set of remote servers. A pair of addresses will therefore always identify a remote server: a local address that identifies the gate to the remote network and a remote address identifying the remote server itself.

3.16
remote client
client that is not directly connected to the main diagnostic network

NOTE A remote client is identified by means of a remote network address. Remote network addresses represent an own address space that is independent from the addresses on the main network.

3.17
permanent DTC
stored in NVRAM and not erasable by any test equipment command or by disconnecting power to the on-board computer

4 Symbols and abbreviated terms

A_PCI Application layer Protocol Control Information

A_PDU Application layer Protocol Data Unit

A_SDU Application layer Service Data Unit

ECU Electronic Control Unit

NOTE An ECU contains at least one server. Systems considered as Electronic Control Units include anti-lock braking system (ABS), engine management system, etc.

NR_SI Negative Response Service Identifier

OBD On-Board Diagnostic

OSI Open Systems Interconnection

RA Remote Address

SA Source Address

SI Service Identifier

TA Target Address

TA_type Target Address type

5 Conventions

This part of ISO 14229 is guided by the conventions discussed in the OSI Service Conventions (ISO 10731) as they apply to 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.

The distinction between service and protocol is summarized in Figure 3.

This part of ISO 14229 defines both, confirmed and unconfirmed services.

— **Confirmed services** use the six (6) service primitives, request, req_confirm, indication, response, rsp_confirm and confirmation.

— **Unconfirmed services** use only the request, req_confirm and indication service primitives.

For all services defined in this part of ISO 14229, the request and indication service primitives always have the same format and parameters. Consequently, for all services the response and confirmation service primitives (except req_confirm and rsp_confirm) always have the same format and parameters. When the service primitives are defined in this part of ISO 14229, only the request and response service primitives are listed.

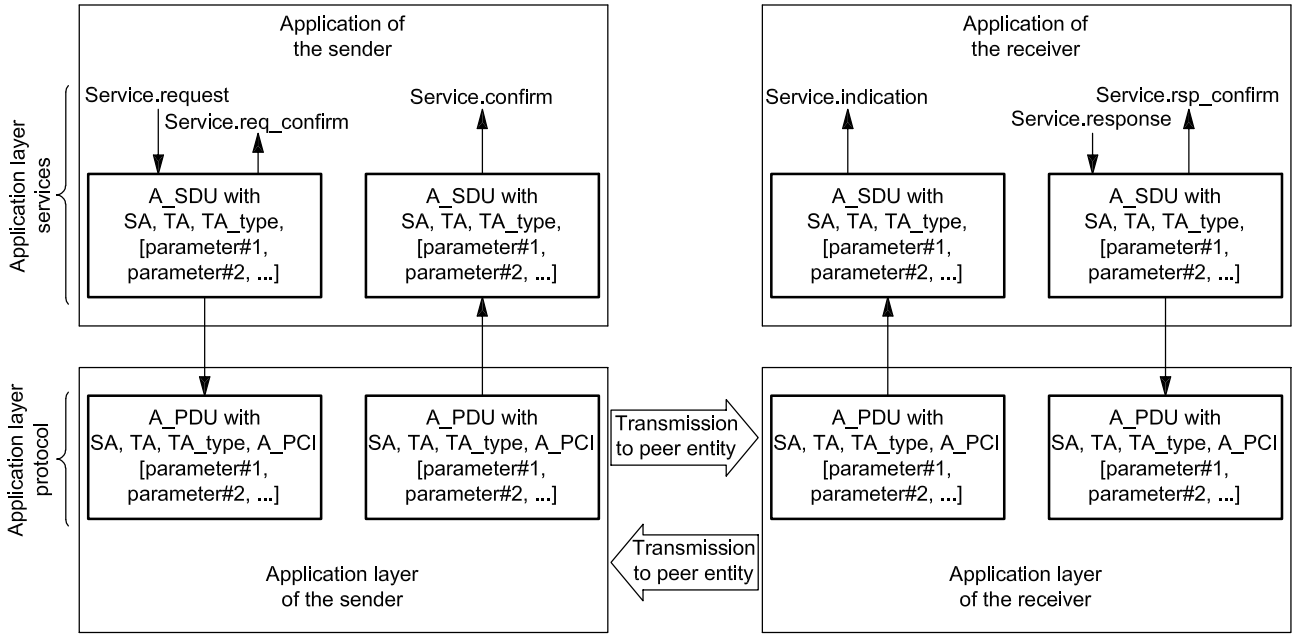

Figure 3 — The services and the protocol

6 Application layer services

6.1 General

Application layer services are usually referred to as diagnostic services. The application layer services are used in client-server-based systems to perform functions such as test, inspection, monitoring or diagnosis of on-board vehicle servers. The client, usually referred to as an External Test Equipment, uses the application layer services to request diagnostic functions to be performed in one or more servers. The server, usually a function that is part of an ECU, uses the application layer services to send response data, provided by the requested diagnostic service, back to the client. The client is usually an off-board tester but can, in some systems, also be an on-board tester. The usage of application layer services is independent from the client being an off-board or on-board tester. It is possible to have more than one client in the same vehicle system.

The service access point of the diagnostics application layer provides a number of services that all have the same general structure. For each service, six (6) service primitives are specified:

— a **service request primitive**, used by the client function in the diagnostic tester application to pass data about a requested diagnostic service to the diagnostics application layer;

— a **service request-confirmation primitive**, used by the client function in the diagnostic tester application to indicate that the data passed in the service request primitive is completely transferred to the server;

— a **service indication primitive**, used by the diagnostics application layer to pass data to the server function of the ECU diagnostic application;

— a **service response primitive**, used by the server function in the ECU diagnostic application to pass response data provided by the requested diagnostic service to the diagnostics application layer;

— a **service response-confirmation primitive**, used by the server function in the ECU diagnostic application to indicate that the data passed in the service response primitive is completely transferred to the client;

— a **service confirmation primitive**, used by the diagnostics application layer to pass data to the client function in the diagnostic tester application.

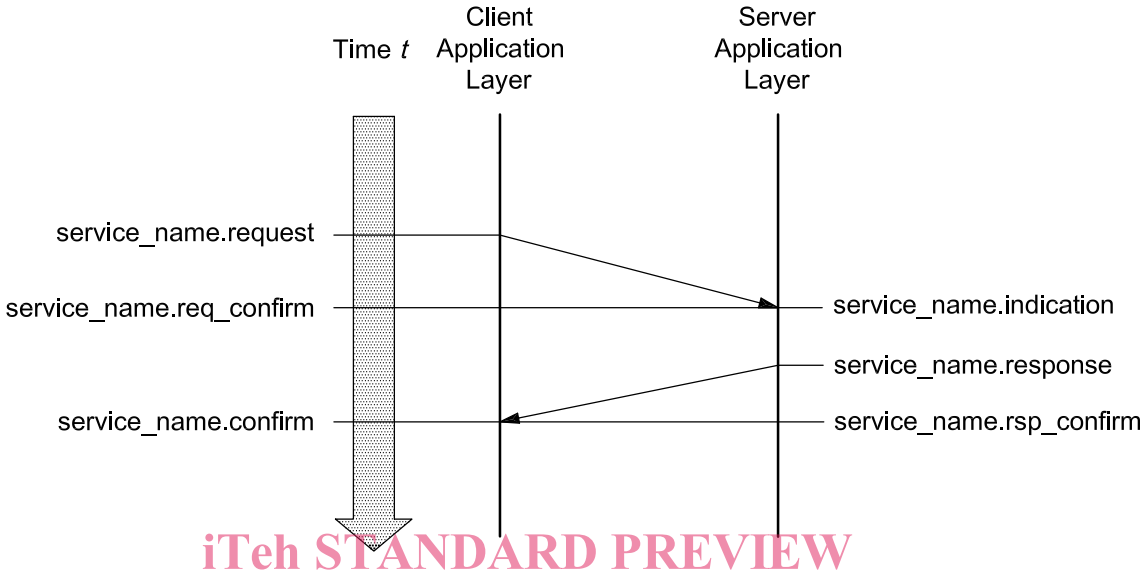

Figure 4 — Application layer service primitives — confirmed service

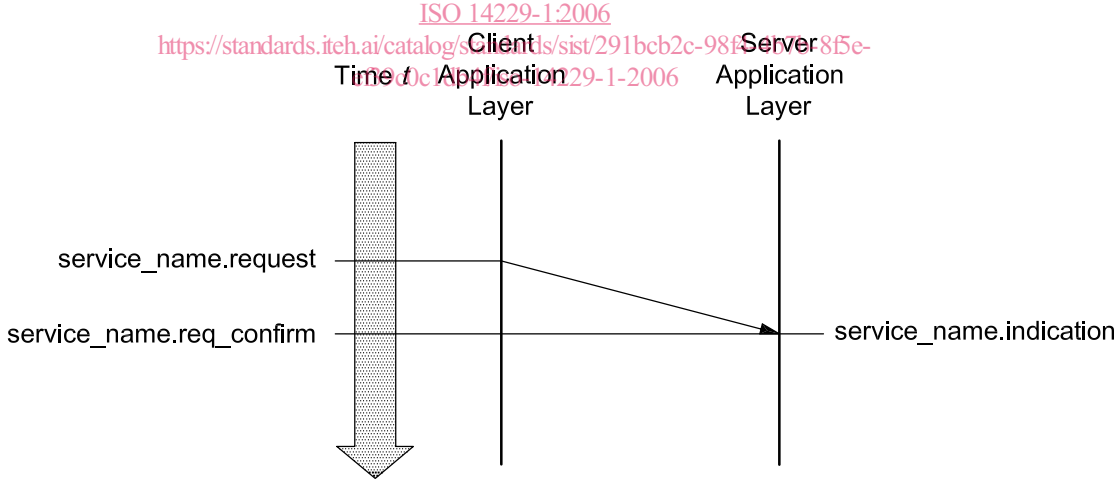

Figure 5 — Application layer service primitives — unconfirmed service

For a given service, the request primitive and the indication primitive always have the same service data unit. This part of ISO 14229 will only list and specify the parameters of the service data unit belonging to each service request primitive. The user shall assume exactly the same parameters for each corresponding service indication primitive.

For a given service, the response primitive and the confirmation primitive always have the same service data unit. This part of ISO 14229 only lists and specifies the parameters of the service data unit belonging to each service response primitive. The user shall assume exactly the same parameters for each corresponding service confirmation primitive.

For each service response primitive (and corresponding service confirmation primitive), two different service data units (two sets of parameters) will be specified. One set of parameters shall be used in a positive service response primitive if the requested diagnostic service can be successfully performed by the server function in the ECU diagnostic application. The other set of parameters (the negative response service data unit) shall be used if the requested diagnostic service fails or cannot be completed in time by the server function in the ECU diagnostic application.

For a given service, the request-confirmation primitive and the response-confirmation primitive always have the same service data unit. The purpose of these service primitives is to indicate the completion of an earlier request or response service primitive invocation. The service descriptions in this part of ISO 14229 do not make use of those service primitives, but the data link specific implementation documents might use them to define e.g. service execution reference points (e.g. the ECUReset service would reset the ECU after the response has been completely transmitted to the client, which is indicated in the server by the service response-confirm primitive).

6.2 Format description of application layer services

Application layer services can have two different formats depending on how the vehicle diagnostic system is configured.

If the vehicle system is configured as a single (one logical) diagnostic network where all clients and servers are connected directly, then the default (also called normal or standard) format of application layer services shall be used. This format is compatible with the diagnostic system formats used on data links such as K- and L-lines. The default application layer services format is specified in 6.3.

The remote format of application layer services shall be used in vehicle systems implementing the concept of local servers and remote servers. The remote format has one additional address parameter called remote address. The remote format is used to access servers that are not directly connected to the main diagnostic network in the vehicle. The remote format for application layer services is specified in 6.4.

6.3 Format description of standard service primitives

6.3.1 General definition

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

```
service_name.type  (
                   parameter A, parameter B, parameter C
                   [,parameter 1, ...]
                   )
```

where:

— “service_name” is the name of the diagnostic service (e.g. DiagnosticSessionControl);

— “type” indicates the type of the service primitive (e.g. request);

— “parameter A, ...” is the A_SDU as a list of values passed by the service primitive (addressing information);

— “parameter A, parameter B, parameter C” are mandatory parameters that shall be included in all service calls;

— “[,parameter 1, ...]” are parameters that depend on the specific service (e.g. parameter 1 can be the diagnosticSession for the DiagnosticSessionControl service). The brackets indicate that this part of the parameter list may be empty.

6.3.2 Service request and service indication primitives

For each application layer service, service request and service indication primitives are specified according to the following general format:

service_name.request (
SA,
TA,
TA_type
[,parameter 1, ...]
)

The request primitive is used by the client function in the diagnostic tester application to initiate the service and pass data about the requested diagnostic service to the application layer.

service_name.indication (
SA,
TA,
TA_type
[,parameter 1, ...]
)

The indication primitive is used by the application layer to indicate an internal event which is significant to the ECU diagnostic application and to pass data about the requested diagnostic service to the server function of the ECU diagnostic application.

The request and indication primitives of a specific application layer service always have the same parameters and parameter values. This means that the values of individual parameters shall not be changed by the communicating peer protocol entities of the application layer when the data is transmitted from the client to the server. The same values that are passed by the client function in the client application to the application layer in the service request call shall be received by the server function of the diagnostic application from the service indication of the peer application layer.

6.3.3 Service response and service confirm primitives

For each confirmed application layer service, service response and service confirm primitives are specified according to the following general format:

service_name.response (
SA,
TA,
TA_type,
Result
[,parameter 1, ...]
)

The response primitive is used by the server function in the ECU diagnostic application, to initiate the service and pass response data provided by the requested diagnostic service to the application layer.

service_name.confirm (
SA,
TA,
TA_type,
Result
[,parameter 1, ...]
)