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Road vehicles — Diagnostic communication over K-Line (DoK-Line) —

Part 2: Data link layer

Véhicules routiers — Communication de diagnostic sur la ligne K (DoK-Line) —
Partie 2: Couche de liaison de données

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Foreword

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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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The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 31, *Data communication*.

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This third edition cancels and replaces the second edition (ISO 14230-2:2013), which has been technically revised.

A list of parts in the ISO 14230 series can be found on the ISO website.

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Introduction

This document has been established in order to define common requirements for vehicle diagnostic systems implemented on K-Line (UART based) communication link, as specified in ISO 14230-1.

To achieve this, it is based on the Open Systems Interconnection (OSI) Basic Reference Model in accordance with ISO/IEC 7498-1 and ISO/IEC 10731, which structures communication systems into seven layers. When mapped on this model, the services specified by ISO 14230 are broken into the following:

— Diagnostic services (layer 7), specified in ISO 14229-1, ISO 14229-6;

— Presentation layer (layer 6):

  — vehicle manufacturer specific;

  — legislated WWH-OBD: ISO 27145-2, SAE 1930-DA, SAE J1979-DA, SAE J2012-DA, SAE J1939:2011, Appendix C (SPN), SAE J1939-73:2010, Appendix A (FMI);

— Session layer services (layer 5):

  — legislated OBD: specified in ISO 14229-2;

  — legislated WWH-OBD: specified in ISO 14229-2;

— Transport layer services (layer 4), specified in ISO 14230-2;

— Network layer services (layer 3), specified in ISO 14230-2;

— Data link layer (layer 2), specified in ISO 14230-4, ISO 14230-2;

— Physical layer (layer 1), specified in ISO 14230-1;

in accordance with Table 1.

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

OSI seven layer[a]	Enhanced diagnostics	Legislated OBD (On-Board Diagnostics)		Legislated WWH-OBD (On-Board Diagnostics)	
Application (layer 7)	ISO 14229-1, ISO 14229-6	ISO 15031-5		ISO 14229-1, ISO 27145-3	
Presentation (layer 6)	vehicle manufacturer specific	ISO 15031-2, ISO 15031-5, ISO 15031-6, SAE J1930-DA, SAE J1979-DA, SAE J2012-DA		ISO 27145-2, SAE 1930-DA, SAE J1979-DA, SAE J2012-DA, SAE J1939:2011, Appendix C (SPN), SAE J1939–73:2010, Appendix A (FMI)	
Session (layer 5)	ISO 14229-2				
Transport (layer 4)	ISO 14230-2	ISO 15765-2	ISO 15765-4	ISO 15765-4, ISO 15765-2	ISO 27145-4
Network (layer 3)					
Data link (layer 2)	ISO 14230-2	ISO 11898-1		ISO 15765-4, ISO 11898-1	
Physical (layer 1)	ISO 14230-1	ISO 11898-1, ISO 11898-2		ISO 11898-1, ISO 11898-2	

[a] Seven layers according to ISO/IEC 7498-1 and ISO/IEC 10731.

The application layer services covered by ISO 14229-6 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.

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ISO 14229-6 is also compatible with most diagnostic services defined in national standards or vehicle manufacturer's specifications.

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Road vehicles — Diagnostic communication over K-Line (DoK-Line) —

Part 2: Data link layer

1 Scope

This document specifies data link layer services tailored to meet the requirements of UART-based vehicle communication systems on K-Line as specified in ISO 14230-1. 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.

The diagnostic communication over K-Line (DoK-Line) protocol supports the standardized service primitive interface as specified in ISO 14229-2.

This document provides the data link layer services to support different application layer implementations like the following:

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- enhanced vehicle diagnostics (emissions-related system diagnostics beyond legislated functionality, non-emissions-related system diagnostics);
- emissions-related OBD as specified in ISO 15031, SAE J1979-DA and SAE J2012-DA;
- in addition, this document clarifies the differences in initialization for K-line protocols defined in ISO 9141 and ISO 14230. This is important since a server supports only one of the protocols mentioned above and the client has to handle the coexistence of all protocols during the protocol determination procedure.

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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 14230-4, *Road vehicles — Diagnostic systems — Keyword Protocol 2000 — Part 4: Requirements for emission-related systems*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

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

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

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

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3.1.1
5 baud initialization
5-BAUD_INIT
starts with bus idle and ends with inverted address byte sent by the server

3.1.2
fast initialization
FAST_INIT
starts with bus idle and ends with the reception of all positive responses of the StartCommunication service from all addressed servers

3.1.3
topology
serial link between client and servers and consists of a K-Line and an optional L-Line

3.1.4
server
function that is part of an electronic control unit and that provides the diagnostic services

3.1.5
client
function that is part of the tester and that makes use of the diagnostic services

Note 1 to entry: A tester normally makes use of other functions such as database management, specific interpretation, human-machine interface.

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3.2 Symbols and abbreviated terms

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5-BAUD_INIT	5-baud initialization
ISO 9141-2 5-BAUD_INIT	Protocol on K-Line according to ISO 9141-2 including 5-BAUD_INIT
ISO 14230-2 5-BAUD_INIT	Protocol on K-Line according to ISO 14230-2 including 5-BAUD_INIT
ISO 14230-2 FAST_INIT	Protocol on K-Line according to ISO 14230-2 including FAST_INIT
ISO 14230-4 5-BAUD_INIT	Protocol on K-Line according to ISO 14230-4 including 5-BAUD_INIT
ISO 14230-4 FAST_INIT	Protocol on K-Line according to ISO 14230-4 including FAST_INIT
bus converter	electronic control unit that links bus systems
client	external test equipment
confirm	confirmation service primitive
Cvt	Convention: M = mandatory, C = conditional, U = user-optional
ECU	electronic control unit
FAST_INIT	fast initialization
FB	first byte
FMT	format byte
gateway	linking hardware between bus systems
DA	destination address
DoK-Line	Diagnostic communication over K-Line

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DoK-Line_SA	data link source address
DoK-Line_TA	data link target address
DoK-Line_TAtype	data link target address type
indication	indication service primitive
LEN	Length byte
Mtype	message type
request	request service primitive
DL_Data	data link data
DoK-Line_PCI	data link protocol control information
DoK-Line_PCItype	data link protocol control information type
DoK-Line_PDU	data link protocol data unit
DoK-Line_SA	data link source address
DoK-Line_SDU	data link service data unit
$P1_{Receiver}$	inter-byte timing parameter of the server
$P2_{Server}$	time between client request and server response or two server responses
$P3_{Client}$	time between end of server responses and start of new client request
$P4_{Sender}$	inter-byte timing parameter of the client
SA	source address
server	electronic control unit (ECU)
TA	target address
UART	universal asynchronous receiver and transmitter
WUP	wake up pattern

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4 Conventions

This document is based on the conventions discussed in the OSI Service Conventions (ISO/IEC 10731) as they apply for 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.

Figure 1 summarizes the distinction between service and protocol.

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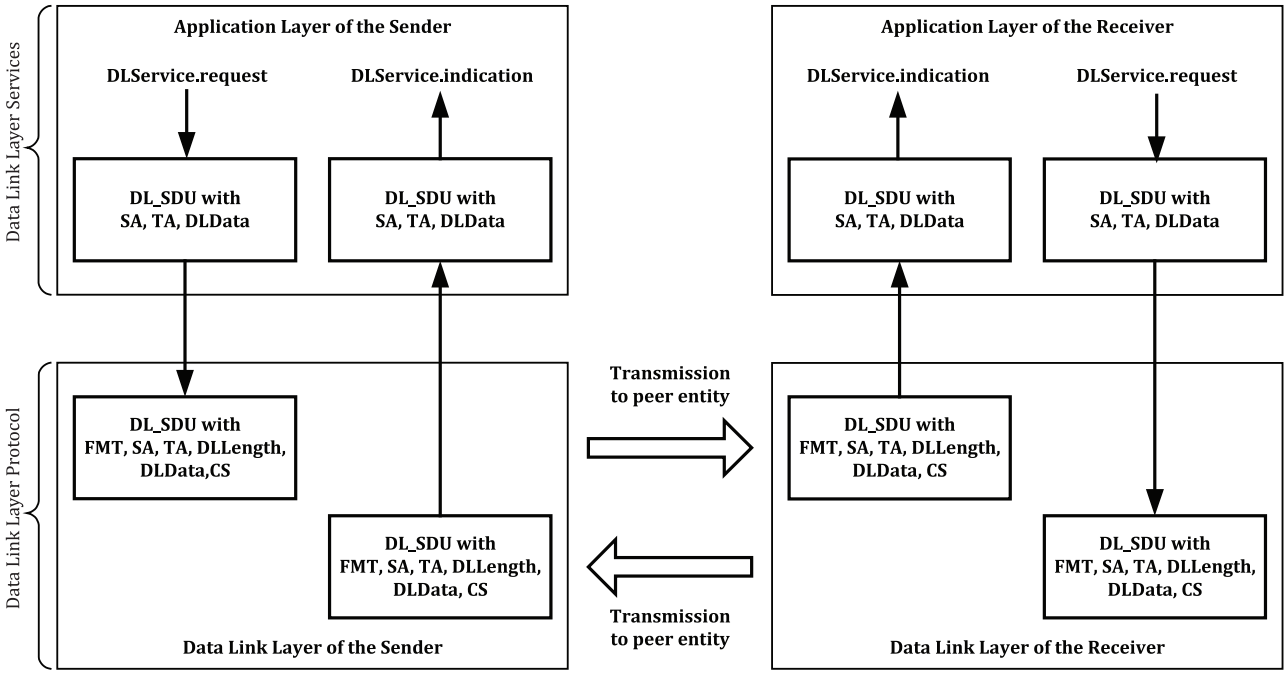

Figure 1 — Services and protocol

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NOTE Figure 1 does not show the confirmation generated on the transmitter side of the message.

This document defines confirmed services. The confirmed services use the three service primitives request, indication and confirmation.

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For all services defined in this document, the request and indication service primitives always have the same format and parameters.

5 Document overview

Figure 2 shows the diagnostic communication over K-Line document reference according to OSI model.

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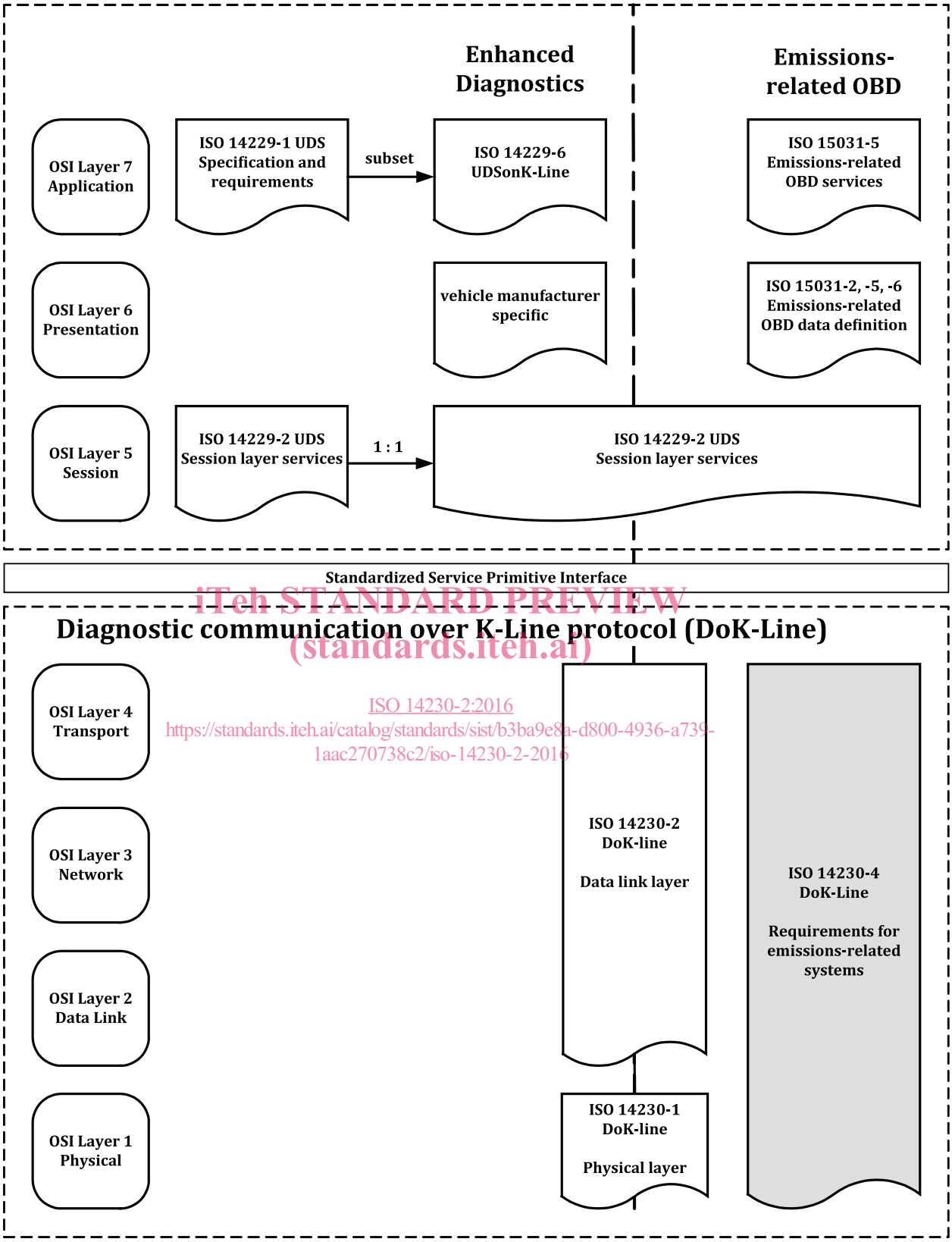

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Figure 2 — DoK-Line document reference according to OSI model

6 Physical bus topology

DoK-Line is a bus concept based on a serial link consisting of one or two physical lines.

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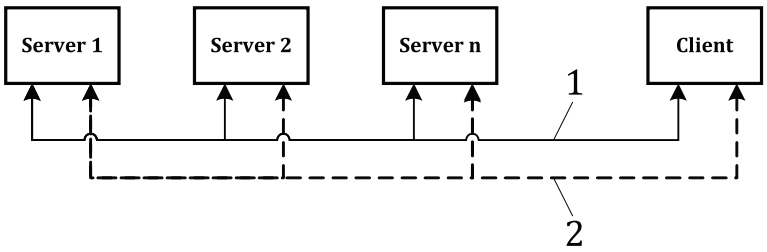
Figure 3 shows the server and client topology.



Key

1 K-Line

2 L-Line (optional)

Figure 3 — Server and client topology

"K-Line" is used for communication and initialization, "L-Line" (optional) is used for initialization only. Special cases are node-to-node connection that means only one server (ECU) on the line, which also can be a bus converter.

The following recommendations apply:

— it is recommended to no longer support the L-Line in server (ECU) hardware;

— client (external test equipment) hardware shall support the L-Line if compliance to ISO 15031-4 is required.

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For more detail, refer to ISO 14230-1 "K-/L-line configurations".

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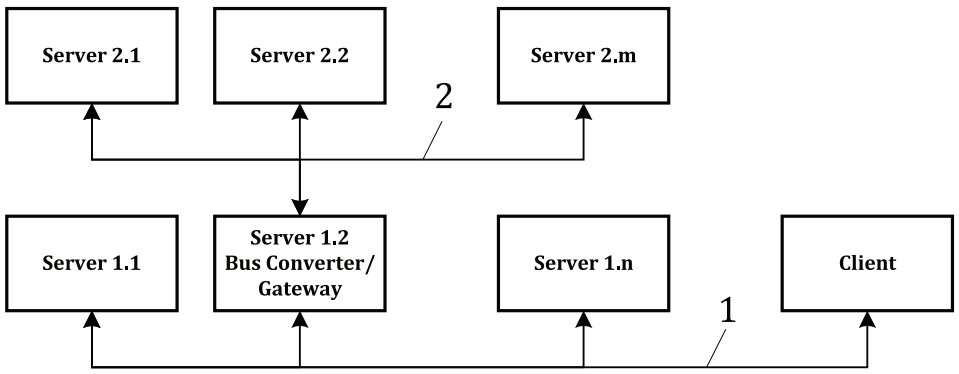
Figure 4 illustrates an example of multiple servers (ECUs) connected with the K-Line to the client (external test equipment). Server 1.2 (ECU 1.2) functions as a gateway (bus converter) and is operating on a bus system (e.g. ISO 15765, SAE J1850).



Key

1 K-Line

2 arbitrary bus system

Figure 4 — Gateway topology example

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7 Data link layer overview

7.1 General

This document specifies the data link layer services which are used in client-server based systems to transmit data from one to the other entity. The client, referred to as external test equipment, uses the data link layer services to transfer diagnostic request data to one or more servers, referred to as an ECU. The server, usually a function that is part of an ECU, uses the data link layer services to send response data, provided by the requested diagnostic service, back to the client. The client is usually external test equipment, but can in some systems also be an on-board test equipment. The usage of data link layer services is independent from the external test equipment being an off-board or on-board test equipment. It is possible to have more than one client (test equipment) in the same vehicle system.

In order to describe the function of the data link layer, services provided to higher layers and the internal operation of the data link layer has to be considered.

7.2 Format description of data link layer services

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

```
service_name.type   (
                    [parameter 1, parameter 2, parameter 3, ...]
                    )
```

where

service_name is the name of the diagnostic service (i.e. DL_Data);

type indicates the type of the service primitive (i.e. request);

[parameter 1, ...] are parameters that depend on the specific service (i.e. parameter 1 can be the source address of the sender). The brackets indicate that this part of the parameter list may be empty.

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7.3 Services provided by the data link layer to higher layers

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

The service access point of the data link layer provides the following service primitives as specified.

— 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.

The following three types of services are defined.

a) **Initialization services**

These services, of which the following are defined, provide the functionality to perform the initialization of the DoK-Line communication.

— DoK-Line_Initialize.request: this service is used to request the DoK-Line communication.

— DoK-Line_Initialize.confirm: this service confirms to the higher layers that the DoK-Line communication has been carried out (successfully or not).

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