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Industrial communications subsystem based on ISO 11898 (CAN) for controller-device interfaces - Part 3: Smart Distributed System (SDS)

Industrial communications subsystem based on ISO 11898 (CAN) for controller-device interfaces -- Part 3: Smart Distributed System (SDS)

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English version

Industrial communications subsystem based on ISO 11898 (CAN) for controller-device interfaces Part 3: Smart Distributed System (SDS)

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Ref. No. EN 50325-3:2001 E

Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 65CX, Fieldbus.

The text of the draft was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 50325-3 on 2000-04-01.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2001-10-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2003-04-01

EN 50325 is divided into three parts:

Part 1 General requirements
Part 2 DeviceNet
Part 3 Smart Distributed System (SDS)

The specifications for DeviceNet and SDS are based on ISO 11898 *Controller area network (CAN) for high-speed communication*, a broadcast-oriented communications protocol. However, ISO 11898 specifies only part of a complete communication system, and additional specifications are needed for other layers to ensure precise data exchange functionality and support of inter-operating devices. The DeviceNet and SDS specifications build on ISO 11898 to describe a complete industrial communication system.

Contents

Introduction

The Smart Distributed System (SDS) is intended for use in, but is not limited to, industrial automation applications. These applications may include devices such as limit switches, proximity sensors, electro-pneumatic valves, relays, motor starters, operator interface panels, analogue inputs, analogue outputs, and controllers.

SDS provides for the connection of intelligent devices such as sensors, actuators and other components to one or more controllers. SDS functionality may be integrated directly into the devices or be in modules allowing the connection of conventional components to the network.

The SDS network consists of one or more controllers connected to up to 126 Logical Devices. In addition to the process data, SDS allows for the transmission of parameters and diagnostic data. The data exchange may be either event driven, cyclical, multicast or polled. A maximum of 6 bytes of data may be transmitted without fragmentation.

Topology is typically a single trunk with short branches using a cable comprising two shielded, twisted pairs with a common earth wire all within a single jacket.

Data is transmitted at rates of 125 kbit/s, 250 kbit/s, 500 kbit/s and 1Mbit/s with maximum system trunk lengths of 457 m, 182 m, 91 m and 22 m respectively.

Detailed information on the performance is contained in clause 5.

Figure 1 shows an example of an SDS Network.

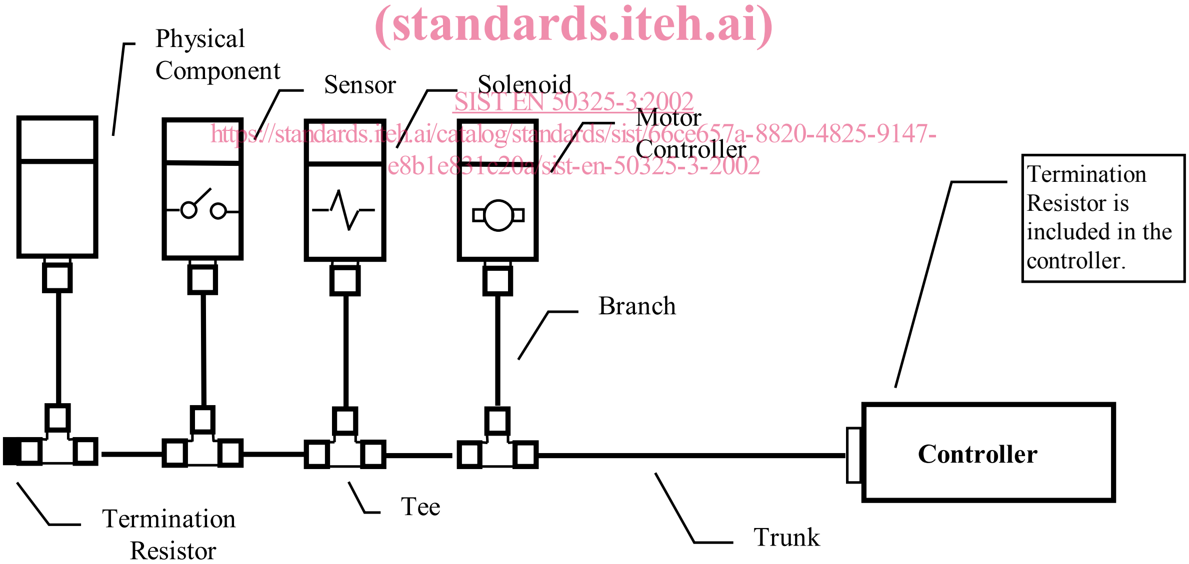

Figure 1 - Example of an SDS Network

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1 Scope

This Part of EN 50325 specifies the following particular requirements for Smart Distributed System (SDS).

- Requirements for interfaces between control devices and switching elements,
- Normal service conditions for devices,
- Constructional and performance requirements,
- Tests to verify conformance to requirements.

2 Normative references

This Part of EN 50325 incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this Part only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 55011	1998	Industrial, scientific and medical (ISM) radio-frequency equipment – Radio disturbance characteristics, limits and methods of measurement (CISPR 11:1997, mod.)
EN 60947-1	1999	Low-voltage switchgear and controlgear Part 1: General rules (IEC 60947-1:1999, mod.)
EN 61000-4-2	1995	Electromagnetic compatibility (EMC) Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test (IEC 61000-4-2:1995)
EN 61000-4-3	1996	Electromagnetic compatibility (EMC) Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test (IEC 61000-4-3:1995, mod.)
EN 61000-4-4	1995	Electromagnetic compatibility (EMC) Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test (IEC 61000-4-4:1995)
EN 61000-4-5	1995	Electromagnetic compatibility (EMC) Part 4-5: Testing and measurement techniques - Surge immunity test (IEC 61000-4-5:1995)
EN 61000-4-6	1996	Electromagnetic compatibility (EMC) Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields (IEC 61000-4-6:1996)
EN 61131-3	1993	Programmable controllers - Part 3: Programming languages (IEC 61131-3:1993)
ISO/IEC 7498-1	1994	Information technology - Open Systems Interconnection Part 1: Basic Reference Model: The Basic Model
ISO TR 8509	1987	Information Processing Systems, Open Systems Interconnection, Service Conventions
ISO 11898	1993	Road vehicles - Interchange of digital information - Controller area network (CAN) for high-speed communication

3 Definitions, abbreviations and symbols

3.1 Definitions

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

3.1.1 Application Layer

The seventh layer of the ISO/OSI Reference Model. (see ISO/IEC 7498-1).

3.1.2 Application Layer Protocol (ALP)

The rules governing the structure and timing of Application Layer Protocol Data Units that are used to achieve the services provided by the application layer.

3.1.3 Application Layer Protocol Data Unit (APDU)

The unit of data transfer exchanged between application layers. It is encapsulated within a Data Link Layer Protocol Data Unit (DLPDU) when transmitted from one component to another.

3.1.4 Application Layer Service

A service provided to the Service User of the application layer. The service may be provided by means of a specified function call.

3.1.5 Autobaud

A network process for determining the network communication baud rate.

3.1.6 Change Of State (COS)

A report that a binary device has changed state.

3.1.7 Change Of Value (COV)

A report that a device input value has changed by a predetermined amount.

3.1.8 Confirm

A representation of an interaction in which a Service Provider indicates, at a particular service access point, completion of some procedure previously invoked, at that service access point, by an interaction represented by a request Primitive. The Confirm is an Application Layer Primitive service. A Confirm notifies the Service User of the presence of the response. (ISO TR 8509)

3.1.9 Data Link Layer Protocol Data Unit (DLPDU)

A protocol data unit at the data link layer.

3.1.10 Embedded Object

A network-addressable entity within a Logical Device. The Embedded Object may be e.g. an embedded interface, an embedded device, an embedded function or an embedded function block.

3.1.11 Embedded Object Identifier

A 5 bit Application Protocol Data Unit field that holds a number used to differentiate between up to 32 Embedded Objects in a Logical Device.

3.1.12 Indication

A representation of an interaction in which an Application Layer Protocol Service Provider indicates that a procedure has been invoked by the Application Layer Protocol Service User at the peer service access point. The Indication is an Application Layer Primitive service. The Indication notifies the Service User of the presence of a request from another device or controller. (ISO TR 8509)

3.1.13 Logical Device

A separate addressable entity within a Physical Component. A Logical Device is connected to the communications channel via its logical address.

3.1.14 Network

All the physical media, connectors, associated communication elements and a given set of communicating devices interconnected for the purpose of communication.

3.1.15 Object Model

A description of behaviour and structure that comprises a set of attributes, a set of actions and a set of events.

3.1.16 Physical Component

A single or modular physical package, including hardware and software and containing one or more Logical Devices, that is connected to the Network.

3.1.17 Physical Layer Interface PLI

The interface between the Physical Component and the communications media.

3.1.18 Primitive

An implementation-independent representation of an interaction between a Service User and a Service Provider. Primitive services exist at the Application Layer level. The Primitives are: Request, Response, Indication and Confirm. (ISO TR 8509)

3.2 Abbreviations

3.2.1	**CAN**	Controller Area Network
3.2.2	**EOID**	Embedded Object Identifier
3.2.3	**FI**	Fragmentation Indicator
3.2.4	**R/R**	Request/Response
3.2.5	**RTR**	Remote Transmission Request
3.2.6	**EUT**	Equipment under Test

3.3 Symbols

3.3.1 (+)

A qualifying suffix used with Result parameter service descriptions. As a Result qualifier, it refers to a successful result in Service Convention diagrams.

3.3.2 (-)

A qualifying suffix used with Result parameter service descriptions. As a Result qualifier, it refers to an unsuccessful result in Service Convention diagrams.

3.3.3 (=)

A qualifying prefix used with Indication and Confirm Primitive service descriptions in Service Convention diagrams. It means that the Primitive is the same as one occurring at a previous level.

4 Relationship with the OSI Reference Model

The SDS protocol is based on a three-layer architecture.

NOTE 1 These layers constitute a collapsed form of the OSI (Open Systems Interconnection) seven layer architecture, mapping onto the physical, data link, and application layers of the OSI Reference Model (ISO/IEC 7498-1).

The Application Layer uses the services provided by the V2.0A CAN Specification data link layer of ISO 11898.

NOTE 2 Figure 2 compares the architecture of the SDS Protocol Model with the OSI Reference Model.

SDS Protocol Model	Corresponding ISO Layers
APPLICATION LAYER	APPLICATION LAYER
|	PRESENTATION LAYER
|	SESSION LAYER
|	TRANSPORT LAYER
|	NETWORK LAYER
CAN DATA LINK LAYER	DATA LINK LAYER
SDS PHYSICAL LAYER	PHYSICAL LAYER

Figure 2 - SDS protocol architecture compared with the OSI Reference Model

5 Characteristics

5.1 SDS Network

5.1.1 Network

An SDS Network consists of Physical Components which include input devices, output devices, PLC interfaces, PC interfaces and interfaces to other Networks, etc. Physical Components are modelled as collections of Logical Devices that communicate over a physical medium. Figure 3 shows a logical representation of an SDS Network.

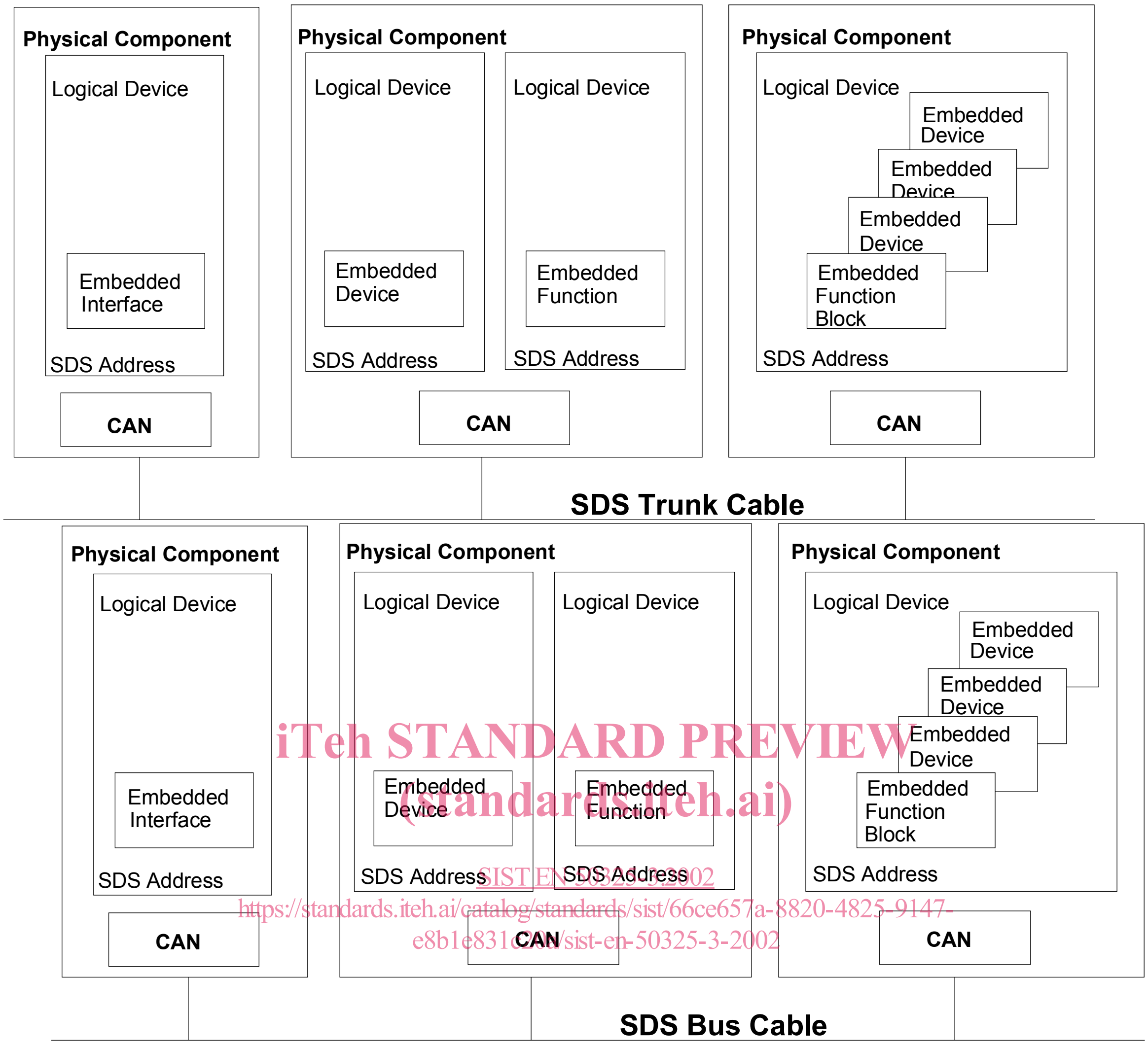

Figure 3 - Logical representation of an SDS Network

5.1.2 Modelling

5.1.2.1 Component Model

Component models represent SDS network visible structure and behaviour of a node. The primary purpose of modelling is to improve the interoperability and interchangeability of SDS components.

The basic SDS component model structure is shown in graphical form in Figure 4. An SDS Physical Component contains at least one Logical Device and provides the connection to the Network. A Logical Device contains at least one and up to 32 SDS Embedded Objects (see 3.1.10). A Physical Component may have several Logical Devices with different SDS Logical Addresses on the Network.

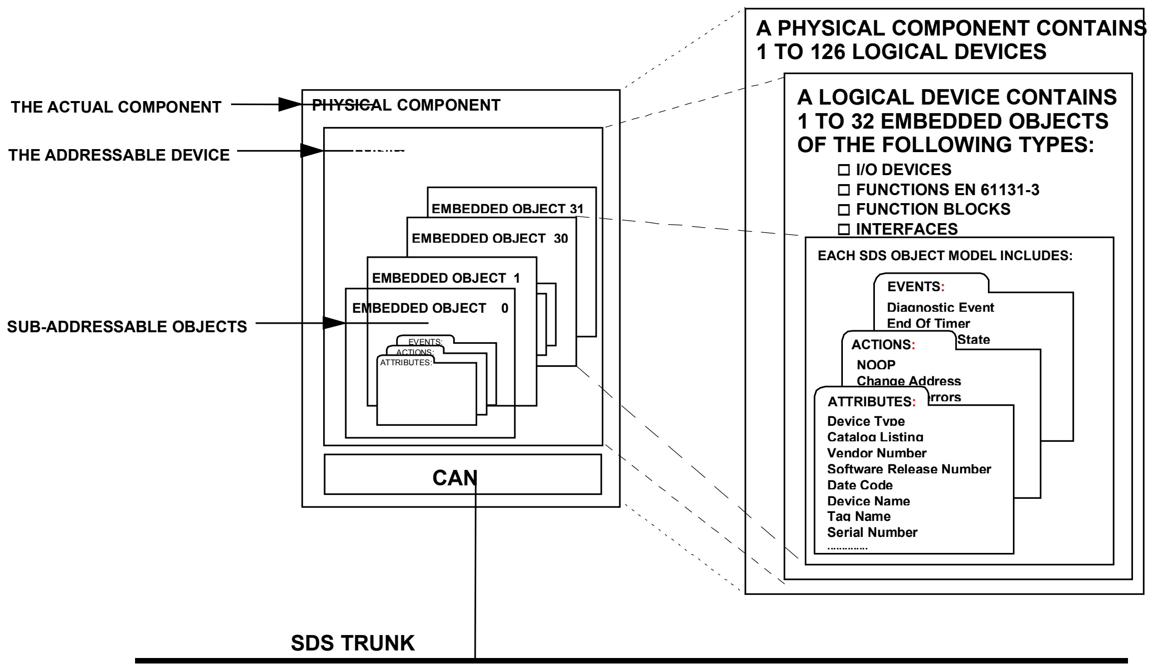

Figure 4 - Graphical representation of Component Model

An SDS Component Model shall include three types of elements: attributes, actions and events. These elements describe the behaviour of an SDS Embedded Object.

5.1.2.2 Attributes

Attributes are containers for the network visible data. Therefore a device network variables shall include the collection of attributes defined by each of its Embedded Objects (figure 4). Each attribute shall have a primitive tag which identifies an associated data type (see 5.3.4) along with data size and/or length specifications. Attributes may be read-only, read-write, or read-write with password protection.

5.1.2.3 Actions

Actions are SDS Embedded Object services which shall be invoked via an action request message which may include data. A device services an action in a manner similar to a subroutine call in a software program. The action response message may also include data.

5.1.2.4 Events

Events are SDS Embedded Object reports. A device shall issue an event as soon as the trigger condition described in the SDS Object Model is true. An event message may include data.

5.1.3 Hierarchy

NOTE SDS defines a mechanism to organize and manage models. These models are separated into major categories and arranged hierarchically.

Figure 5 shows the overview of the standard SDS hierarchy. The SDS Minimum Model specifies a minimum set of features that every device shall support. These features shall be inherited by other models such as I/O Devices, Interface Devices, etc., each of which shall also specify its own set of attributes, actions and events. These may in turn be inherited by other models which add another set of features. A particular model shall support the features of all the models it inherits.

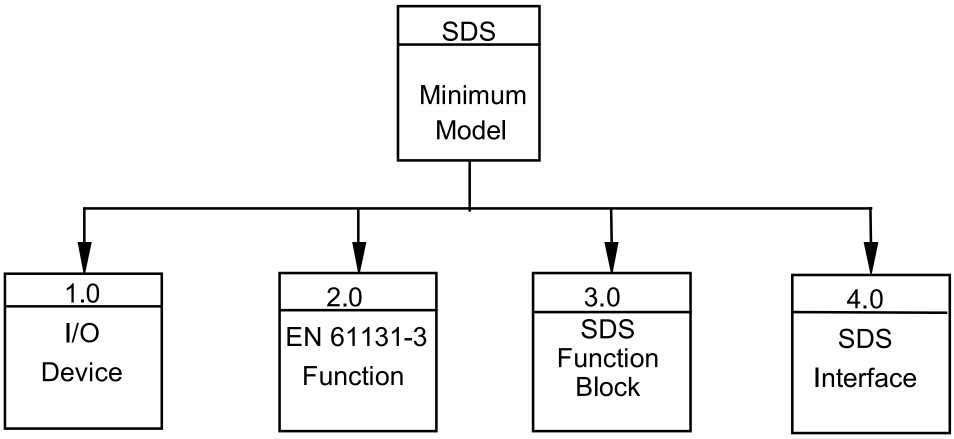

Figure 5 - SDS example of Models in hierarchical form

The topmost level of the hierarchy defines the structure and minimum behaviour of the Physical Component and Logical Device in the SDS Model. Every SDS product shall include this top level. Each lower level of the hierarchy defines additional SDS attributes, actions and events for SDS Embedded Objects at that level. SDS Embedded Objects at each level of the hierarchy shall inherit all of the features from all previous levels. A Logical Device may contain up to 32 Embedded Objects in any combination.

5.2 SDS Application Layer Services

5.2.1 Service conventions

The Application Layer shall provide the services listed in Table 1.

Table 1 - SDS Application Layer Services

Service	Function
Read	Allows the ALP service user to read the value of a device attribute.
Write	Allows the ALP service user to modify the value of a device attribute.
Event	Allows an ALP service user to report an event.
Action	Allows an ALP service user to command a device to execute an action.
Change Of State–ON	Specialized event service that reports a Change Of State to the ON condition of a binary Device Model
Change Of State–OFF	Specialized event service that reports a Change Of State to the OFF condition of a binary Device Model
Write State–ON	Specialized write service that writes an ON state to a binary output device
Write State–OFF	Specialized write service that writes an OFF state to a binary output device