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Industrial automation systems and integration — Open systems application integration framework —

Part 2: Reference description for ISO 11898-based control systems

Systèmes d'automatisation industrielle et intégration — Cadres d'intégration d'application pour les systèmes ouverts —

Partie 2: Description de référence pour les systèmes de contrôle fondés sur l'ISO 11898

Reference number
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Foreword

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ISO 15745-2 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration,* Subcommittee SC 5, *Architecture, communications and integration frameworks.*

ISO 15745 consists of the following parts, under the general title *Industrial automation systems and integration — Open systems application integration framework:*

— *Part 1: Generic reference description*

— *Part 2: Reference description for ISO 11898-based control systems*

— *Part 3: Reference description for IEC 61158-based control systems*

— *Part 4: Reference description for Ethernet-based control systems*

Introduction

The application integration framework (AIF) described in ISO 15745 defines elements and rules that facilitate:

— the systematic organization and representation of the application integration requirements using integration models;

— the development of interface specifications in the form of application interoperability profiles (AIPs) that enable both the selection of suitable resources and the documentation of the "as built" application.

ISO 15745-1 defines the generic elements and rules for describing integration models and AIPs, together with their component profiles - process profiles, information exchange profiles, and resource profiles. The context of ISO 15745 and a structural overview of the constituents of an AIP are given in Figure 1 of ISO 15745-1:2003.

This part of ISO 15745 extends the generic AIF described in ISO 15745-1 by defining the technology specific elements and rules for describing both communication network profiles and the communication related aspects of device profiles specific to ISO 11898-based control systems (DeviceNet[1] , CANopen[2]).

In particular, this part of ISO 15745 describes technology specific profile templates for the device profile and the communication network profile. Within an AIP, a device profile instance or a communication network profile instance is part of the resource profile defined in ISO 15745-1. The device profile and the communication network profile XML instance files are included in a resource profile XML instance using the ProfileHandle_DataType as specified in ISO 15745-1:2003, 7.2.5.

AIFs specified using the elements and rules of ISO 15745-1 can be easily integrated with the component profiles defined using the elements and rules specified in this part.

1) DeviceNet™ is a trade name of Open DeviceNet Vendor Association, Inc. This information is given for the convenience of users of ISO 15745 and does not constitute an endorsement by ISO of the trademark holder or any of its products. Compliance to this standard does not require use of the trade name DeviceNet™. Use of the trade name DeviceNet™ requires permission of the Open DeviceNet Vendor Association, Inc.

2) CANopen is a trade name used to describe EN 50325-4. This information is given for the convenience of users of ISO 15745 and does not constitute an endorsement by ISO of the trademark, or any related products. Compliance to this standard does not require use of the trade name CANopen.

Industrial automation systems and integration — Open systems application integration framework —

Part 2: Reference description for ISO 11898-based control systems

1 Scope

This part of ISO 15745 defines the technology specific elements and rules for describing both communication network profiles and the communication related aspects of device profiles specific to ISO 11898-based control systems.

NOTE Generic elements and rules for describing integration models and application interoperability profiles, together with their component profiles (process profiles, information exchange profiles, and resource profiles) are specified in ISO 15745-1.

This part of ISO 15745 is to be used in conjunction with ISO 15745-1 to describe an application integration framework.

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 639-1:2002, *Codes for the representation of names of languages – Part 1: Alpha-2 code*

ISO 639-2:1998, *Codes for the representation of names of languages – Part 2: Alpha-3 code*

ISO 3166-1:1997, *Codes for the representation of names of countries and their subdivisions – Part 1: Country codes*

ISO/IEC 10646-1:2000, *Information technology – Universal Multiple-Octet Coded Character Set (UCS) – Part 1: Architecture and Basic Multilingual Plane*

ISO 11898:1993, *Road Vehicles – Interchange of digital information – Controller area network (CAN) for high-speed communication*

ISO 15745-1:2003, *Industrial automation and systems integration – Open systems application integration framework – Part 1 : Generic reference description*

IEC 61158 (all parts), *Digital data communications for measurement and control – Fieldbus for use in industrial control systems*

IEC 61784-1:2003, *Digital data communications for measurement and control – Part 1: Profile sets for continuous and discrete manufacturing relative to fieldbus use in industrial control systems*

IEC 62026-3:2000, *Low-voltage switchgear and controlgear – Controller-device interfaces (CDIs) – Part 3: DeviceNet*™

EN 50325-4 : 2002, *Industrial communications subsystem based on ISO 11898 (CAN) for controller-device interfaces – Part 4 : CANopen*

IEEE Std 754-1985 (R1990), *IEEE Standard for Binary Floating-Point Arithmetic*

REC-xml-20001006, *Extensible Markup Language (XML) 1.0 Second Edition – W3C Recommendation 6 October 2000*

REC-xmlschema-1-20010502, *XML Schema Part 1: Structures – W3C Recommendation 02 May 2001*

REC-xmlschema-2-20010502, *XML Schema Part 2: Datatypes – W3C Recommendation 02 May 2001*

RFC 1738:1994, *Uniform Resource Locators (URL) – Internet Engineering Task Force (IETF), Request for Comments (RFC)*

RFC 1759:1995, *Printer MIB – Internet Engineering Task Force (IETF), Request for Comments (RFC)*

UML V1.4, *OMG - Unified Modeling Language Specification (Version 1.4, September 2001)*

3 Terms and definitions

NOTE The UML terminology and notation used in this document is described in Annex A of ISO 15745-1:2003.

For the purposes of this document, the terms and definitions given in ISO 15745-1 apply.

4 Abbreviated terms

AIF Application Integration Framework

AIP Application Interoperability Profile

CAN Controller Area Network

CIP™[3] Common Industrial Protocol

EDS Electronic Data Sheet

IAS Industrial Automation Systems

OSI Open System Interconnection

UML Unified Modelling Language (see UML V1.4)

XML eXtensible Markup Language (see REC-xml-20001006)

[3] CIP™ is a trade name of ControlNet International, Ltd. and Open DeviceNet Vendor Association, Inc. This information is given for the convenience of users of ISO 15745 and does not constitute an endorsement by ISO of the trademark holder or any of its products. Compliance to this standard does not require use of the trade name CIP™. Use of the trade name CIP™ requires permission of either ControlNet International, Ltd. or Open DeviceNet Vendor Association, Inc

5 Technology specific elements and rules

5.1 Integration models and IAS interfaces

The AIP developer shall develop the integration model using the rules described in ISO 15745-1, and shall ensure that the ISO 11898-based device and communication network profiles (whether representing the interface requirements or those derived from existing devices/communication networks) include the necessary IAS interfaces. The IAS interfaces included in the profile shall be identified in the header section (see ISO 15745-1:2003, 7.2.2).

NOTE IAS interfaces are described in ISO 15745-1:2003, Annex B.

5.2 Profile templates

5.2.1 General

The ISO 11898-based technology specific profile templates are derived from the generic profile templates specified in ISO 15745-1:2003, clause 7.

5.2.2 Contents and syntax

ISO 15745 specifies profile templates that are XML schemas (REC-xmlschema-1-20010502 and REC-xmlschema-2-20010502) and use a common general structure. The device and communication network profiles based on these templates typically contain:

— information needed to identify the connected device;

— a description of device data that can be accessed via the network;

— a description of the communication capabilities supported by the device;

— additional vendor-specific information.

However, some ISO 11898-based technologies use specific legacy ASCII syntax. Hence, for backward compatibility, template definitions of any technology (Annex A to Annex B) include all or a relevant subset of the following:

— communication network and device profile templates, as defined in ISO 15745-1;

— ISO 15745 template to encapsulate files with legacy ASCII syntax ("wrapper");

— legacy ASCII syntax.

5.2.3 Header

The profile template header defined in ISO 15745-1:2003, 7.2.2, is used for ISO 11898 technology specific profile templates. Each technology uses one or more names to identify the technology or its particular component(s) (see Table 1). The selected name shall be stored in the ProfileTechnology attribute in the header section.

Table 1 — ProfileTechnology names

ProfileTechnology name	Technology
DeviceNet	DeviceNet
CIP	DeviceNet
EDS	DeviceNet
CANopen	CANopen
COFDCML	CANopen

5.3 Technology specific profiles

The technology specific communication network profile structure and communication related aspects of device profile structure based on ISO 11898-based technologies are described in clause 6. The technologies included are:

— DeviceNet (see 6.1);

— CANopen (see 6.2).

The related profile template definitions are specified in Annex A and Annex B.

6 Device and communication network profiles for ISO 11898-based control systems

6.1 DeviceNet

6.1.1 Device profile

6.1.1.1 General

Figure 1 shows the class structure of the DeviceNet device profile.

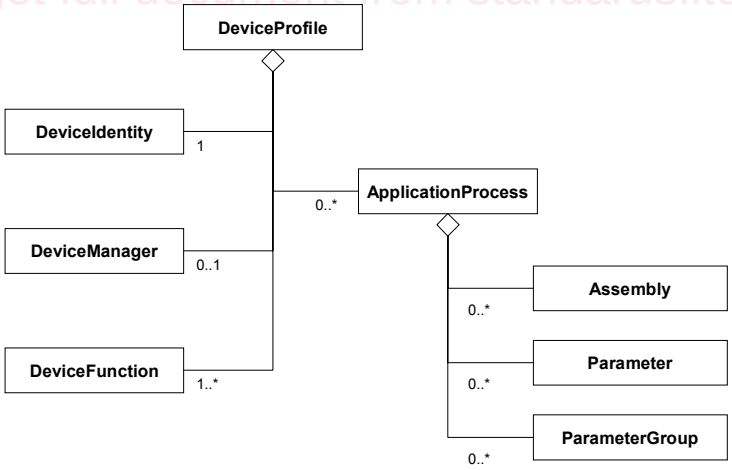

Figure 1 — DeviceNet device profile class diagram

The available formats for DeviceNet device profiles are described in A.2.

The XML schema representing the DeviceNet device profile template is defined in A.2.1.3.3. The file name of this XML schema shall be “CIP_Device_Profile.xsd”.

NOTE The DeviceNet device profile class diagram shown in Figure 1 defines the main classes. These classes are further decomposed ; details are defined in Annex A.

The XML schema representing the encapsulation of a legacy DeviceNet EDS into the ISO 15745 device profile template is defined in A.2.2.2. The file name of this XML schema shall be “EDS_Device_Profile_wrapper.xsd”. The legacy EDS ASCII syntax itself is described in A.4.

6.1.1.2 Device identity

The DeviceIdentity class contains attributes which uniquely identify the device, and supports services which allow the retrieval of this information from the device.

These attributes provide in particular:

— manufacturer's identification (name and identification code);

— device identification (device type, product name, revision, serial number);

— device classification;

— location of storage of additional information (e.g. icons).

6.1.1.3 Device manager

The DeviceManager class contains attributes and supports services used to monitor and configure the device.

These attributes provide in particular:

— revision of the DeviceNet identity object;

— information on device structure (for devices integrated in a modular system).

Services allow:

— device reset;

— retrieval of DeviceManager attributes.

6.1.1.4 Device function

The DeviceFunction class contains attributes and supports services which enable the management (e.g. configuration) of a function of the device.

EXAMPLE Examples of DeviceFunction objects are Overload, Presence Sensing, Analogue Input, and Discrete Output objects.

NOTE The definition of specific DeviceFunction class is not defined in ISO 15745-2.

6.1.1.5 Application process

Figure 2 shows the class structure of the ApplicationProcess class.

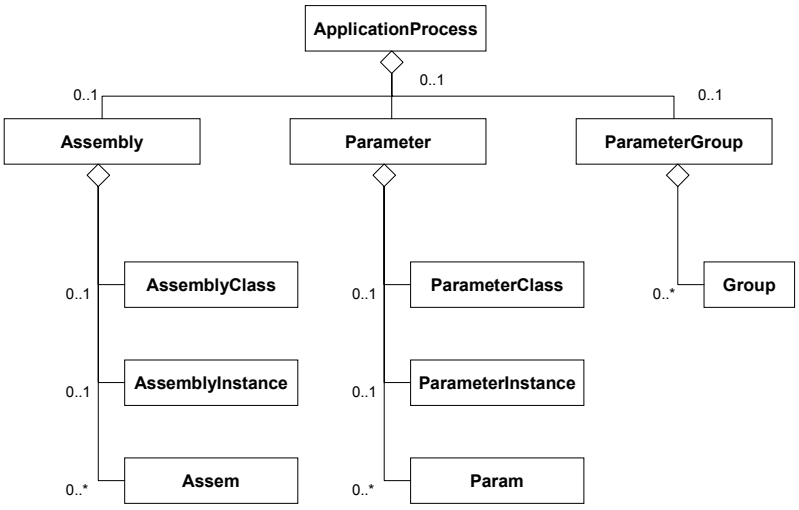

Figure 2 — DeviceNet ApplicationProcess class diagram

The Assembly class assembles several application process data items into a single block for optimisation of communications. The Parameter class provides a standardized interface for accessing individual application process data items. The ParameterGroup class specifies groups of related parameters for a specific purpose (e.g. configuration, monitoring). The Assembly class and the Parameter class support attributes and services both at the class and instance levels.

The Assem, Param and Group classes specify individual instances of the main classes.

NOTE The Assembly class and the Parameter class correspond to the DeviceNet Assembly object and Parameter objects. The Assembly object is fully specified in IEC 61158-5:2003 and IEC 61158-6:2003 (Type 2).

6.1.2 Communication network profile

6.1.2.1 General

Figure 3 shows the class structure of the DeviceNet communication network profile.

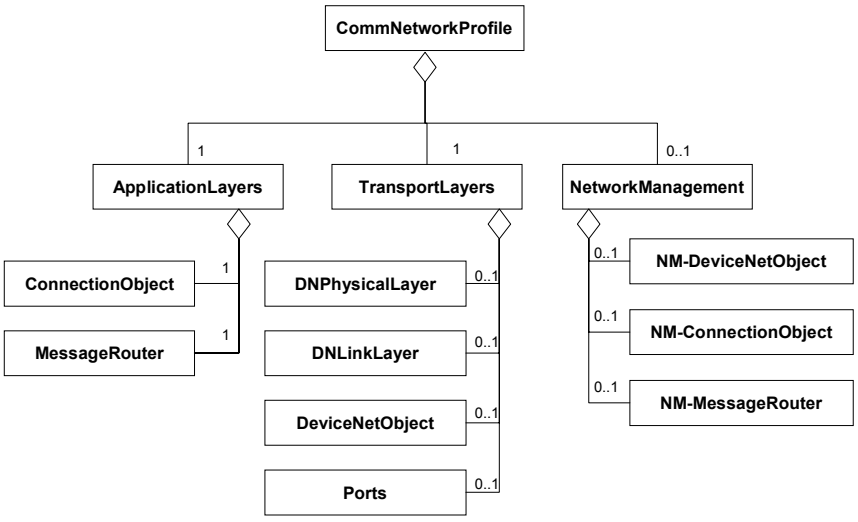

Figure 3 — DeviceNet communication network profile class diagram

The available formats for DeviceNet communication network profiles are described in A.3.

The XML schema representing the DeviceNet communication network profile template is defined in A.3.1.3. The file name of this XML schema shall be “DNet_CommNet_Profile.xsd”.

The XML schema representing the encapsulation of a legacy DeviceNet EDS into the ISO 15745 communication network profile template is defined in A.3.2.2. The file name of this XML schema shall be “EDS_CommNet_Profile_wrapper.xsd”. The legacy EDS ASCII syntax itself is described in A.4.

6.1.2.2 Application layers

The DeviceNet ApplicationLayers class represents the combined profiles for the upper 3 OSI layers of the DeviceNet communication network integration model.

It is further divided into several classes, as shown in Figure 3:

— ConnectionObject defines the properties associated with connections and connection management;

— MessageRouter defines the properties associated with internal message routing in the device.

NOTE The corresponding Connection object and Message Router object are fully specified in IEC 62026-3:2000.

6.1.2.3 Transport layers

The DeviceNet TransportLayers class represents the combined profiles for the lower 4 OSI layers of the DeviceNet communication network integration model.

It is further divided into several classes, as shown in Figure 3:

— DNPhysicalLayer identifies the physical layer characteristics (e.g. connectors, baudrates, electrical characteristics);

— DNLinkLayer and DeviceNetObject define the properties associated with data link layer configuration and monitoring;

— Ports identifies the device ports which are able to route messages from one link to another link.

NOTE The corresponding DeviceNet object is fully specified in IEC 62026-3:2000.

6.1.2.4 Network management

The DeviceNet NetworkManagement class represents the network configuration and performance adjustment capabilities of the DeviceNet communication network integration model.

It is further divided into several classes, as shown in Figure 3:

— NM-DeviceNetObject, NM-ConnectionObject and NM-MessageRouter define the properties associated with class management of the corresponding objects.

6.2 CANopen

6.2.1 Device profile

6.2.1.1 General

Figure 4 shows the class structure of the CANopen device profile.

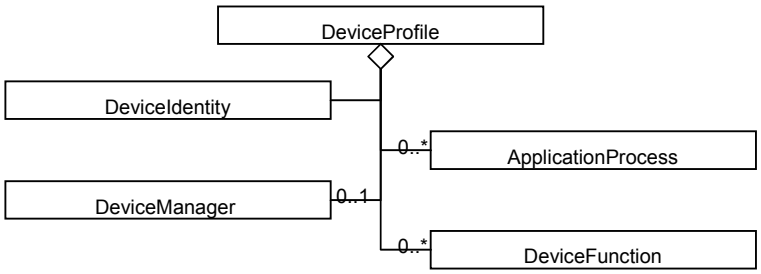

Figure 4 — CANopen device profile class diagram

The required format for CANopen device profiles is described in B.1. The XML schema representing the CANopen device profile template is defined in B.1.5.1. The file name of the XML schema shall be 'COFDCML.xsd'.

NOTE 1 For better readability the CANopen DeviceProfile class diagram has been divided in five class diagrams.

NOTE 2 All these classes are mapped to the same XML schema defined in B.1.5.1.

NOTE 3 The CANopen device profile class diagrams shown in Figure 4 to Figure 10 define the main classes. Some classes are further decomposed; details are defined in Annex B.

6.2.1.2 Device identity

The DeviceIdentity class is defined in Figure 5.

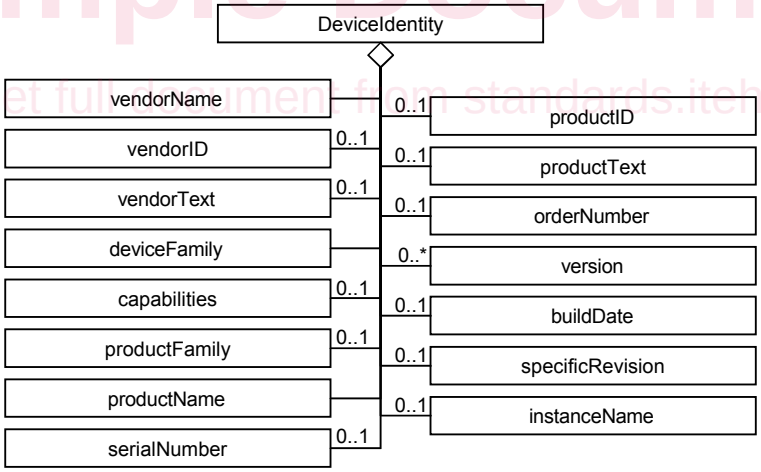

Figure 5 – DeviceIdentity class diagram

The DeviceIdentity class shall consist of the child classes shown in Figure 5 and specified in Table 2.

Table 2 - Decomposition of Device identity object class

Class	Description	Profile	Type	Instance
vendorName	name of the manufacturer or vendor of the device	X	X	X
vendorID	IEEE OUI (Organizationally Unique Identifier) (see[6])		X	X
vendorText	can be used to provide further information on the vendor	X	X	X
deviceFamily	the definition of this class is is not defined in this standard	X	X	X

Class	Description	Profile	Type	Instance
capabilities	the definition of this class is not defined in this standard		X	X
productFamily	vendor specific product family (brand name) of the device		X	X
productName	vendor specific name of the product	X	X	X
productID	unique ID, identifying the device type, the format is at the vendor's discretion		X	X
productText	can be used to provide further information on the device	X	X	X
orderNumber	vendor specific order number of the product		X	X
version	vendor specific product version, the versionType attribute allows the distinction of multiple versions (i.e. Hardware, Firmware)		X	X
buildDate	build date of the firmware of software constituting the major functionality of the device		X	X
specificationRevision	revision of the specification to which this device conforms	X	X	X
instanceName	name of device instance			X
serialNumber	serial number of device instance			X
NOTE The columns Profile, Type and Instance indicate whether a certain child class is suitable for usage in a device profile, device type description or device instance description.				

6.2.1.3 Device manager

6.2.1.3.1 General

Figure 6 shows the CANopen representation of the DeviceManager object.

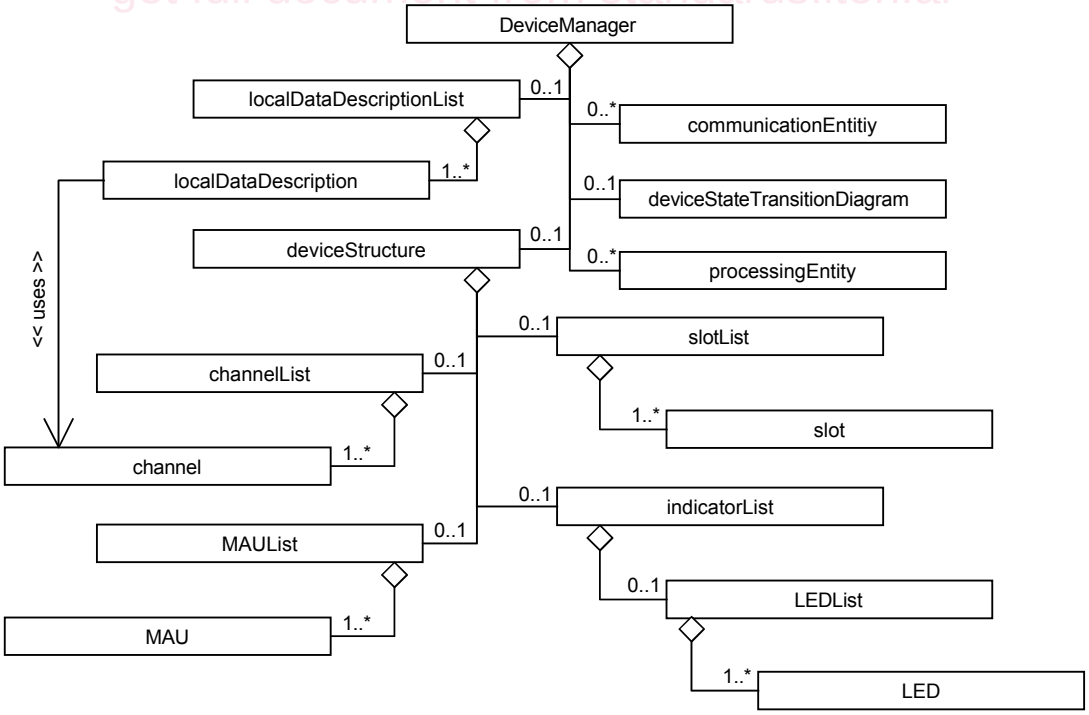

Figure 6 – DeviceManager class diagram