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

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

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Foreword

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ISO 15745-3 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*:

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— *Part 1: Generic reference description*

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— *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*

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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 control systems based on IEC 61158 (P-NET®[1], PROFIBUS[2], WorldFIP®[3], ControlNet™[4], and INTERBUS®[5]). These technologies use profiles of IEC 61158 which are specified in IEC 61784-1. Profiles for ISO/IEC 8802-3-based control systems are outside the scope of this part of ISO 15745 and are specified in ISO 15745-4.

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.

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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.

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

Part 3:
Reference description for IEC 61158-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 IEC 61158-based control systems. Profiles for ISO/IEC 8802-3-based control systems are outside the scope of this part of ISO 15745.

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.

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2 Normative references

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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 9506-1:2000, *Industrial automation systems – Manufacturing Message Specification – Part 1: Service definition*

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

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

IEC 61131-3:2003, *Programmable controllers – Part 3: Programming languages*

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*

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IEC 61804-2, *Function blocks (FB) for process control – Part 2: Specification of FB concept and electronic device description language (EDDL)*[6]

ANSI TIA/EIA-232-F:1997, *Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange*

ANSI TIA/EIA-485-A:1998, *Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems*

EN 50170:1996 Volume 3 Part 7-3, *General purpose field communication system – WorldFIP – Network Management*

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)*

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3 Terms and definitions

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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.

[6] Edition 1 to be published

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4 Abbreviated terms

AIF	Application Integration Framework
AIP	Application Interoperability Profile
AL	Application Layer
ASCII	American Standard Code for Information Interchange (see ISO/IEC 10646)
ASE	Application Service Element (see IEC 61158-5)
CIP™[7]	Common Industrial Protocol
CP	Communication Profile
CRC	Cyclic Redundancy Check
DL	Data Link Layer
DP	PROFIBUS DP services and protocol
EDD	Electronic Device Description
EDDL	Electronic Device Description Language
EDS	Electronic Data Sheet
FDCML	Field Device Configuration Markup Language
FIP	Field Industrial Protocol
GSD	Generic Station Description
HMI	Human Machine Interface
I/O	Input and Output
IAS	Industrial Automation Systems
ID	Identifier
kbit/s	1024 bit/s
LSB	Least Significant Bit
MAU	Medium Attachment Unit
Mbit/s	1024*1024 bits/s
MCS	Messaging Common Services
MMS	Manufacturing Messages Specifications (see ISO 9506-1)
MPS	Manufacturing Periodic/aperiodic Services
MS1	Master class 1 (see IEC 61784-1:2003)
MS2	Master class 2 (see IEC 61784-1:2003)

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NC	Numerical Control
NM	Network Management
OSI	Open System Interconnection
PC	Personal Computer
PID	Proportional Integration Differentiation controller
PLC	Programmable Logic Controller
RC	Robot Control
SM_MPS	System Management Manufacturing Periodic Specification
SMS	System Management Specification
SubMMS	Subset of MMS
SWNo	Softwire Number
UML	Unified Modelling Language (see UML V1.4)
VMD	Virtual Managed Device
XML	eXtensible Markup Language (see REC-xml-20001006)

5 Technology specific elements and rules

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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 IEC 61158-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).

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

5.2 Profile templates

5.2.1 General

The IEC 61158 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.

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However, some IEC 61158 technologies use specific legacy ASCII syntax. Hence, for backward compatibility, template definitions of any technology (Annex A to Annex E) 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 IEC 61158 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
ControlNet	ControlNet
CIP	ControlNet
EDS	ControlNet
GSD	PROFIBUS
EDDL	PROFIBUS
P-NET	P-NET
WorldFIP	WorldFIP
INTERBUS	INTERBUS
FDCML	INTERBUS

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5.3 Technology specific profiles

The technology specific communication network profile structure and communication related aspects of device profile structure based on IEC 61158 fieldbus technologies are described in clause 6. The technologies included are:

— ControlNet (see 6.1)

— PROFIBUS (see 6.2)

— P-NET (see 6.3)

— WorldFIP (see 6.4)

— INTERBUS (see 6.5).

The related profile template definitions are specified in Annex A to Annex E.

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6 Device and communication network profiles for IEC 61158-based control systems

6.1 ControlNet

6.1.1 Device profile

6.1.1.1 General

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

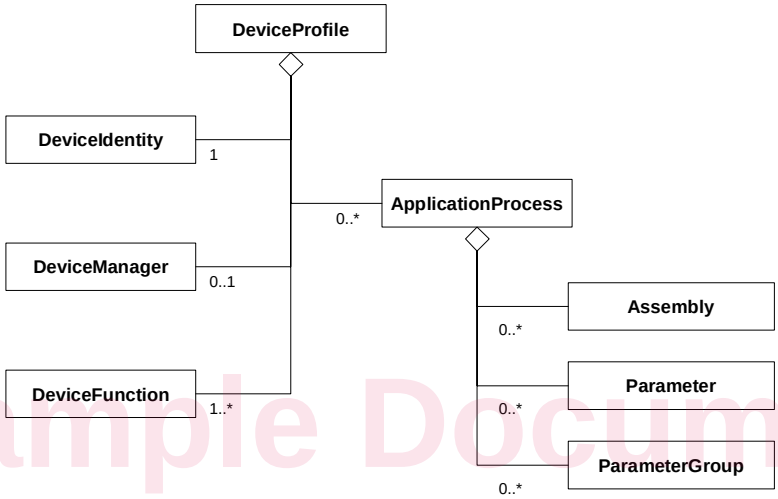

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Figure 1 — ControlNet device profile class diagram

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

The XML schema representing the ControlNet 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 ControlNet 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 ControlNet 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).

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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 ControlNet 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 DeviceFunction class is not defined in ISO 15745-3.

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6.1.1.5 Application process

Figure 2 shows the class structure of the ApplicationProcess class.

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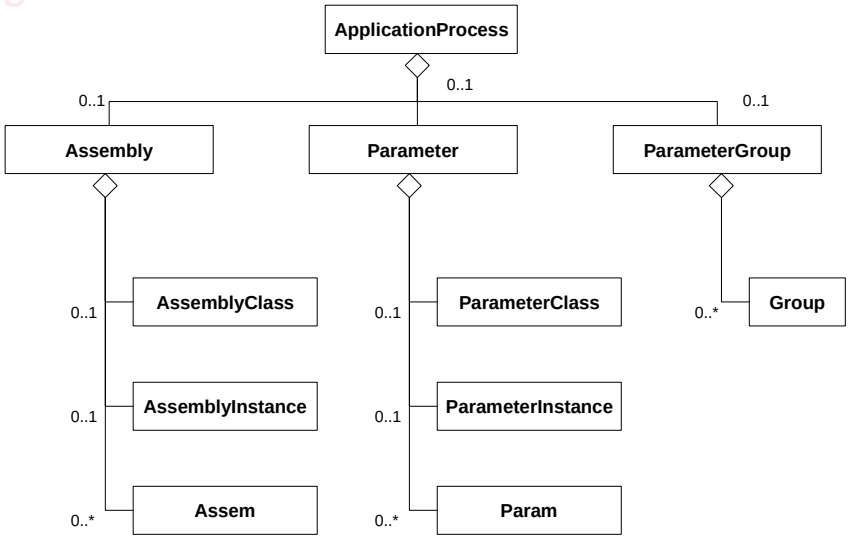

Figure 2 — ControlNet ApplicationProcess class diagram

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.

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

NOTE The Assembly class and the Parameter class correspond to the ControlNet Assembly object and Parameter object. 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 ControlNet communication network profile.

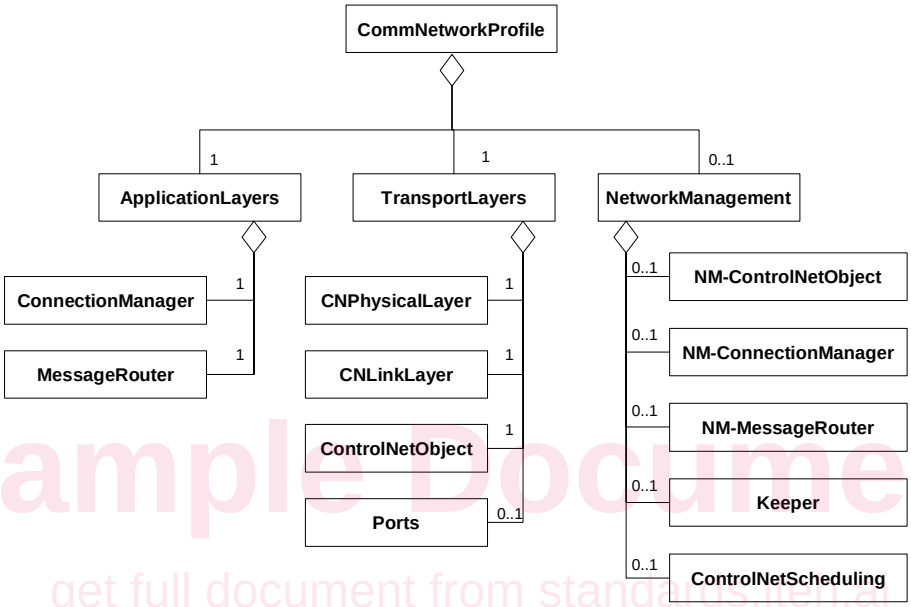

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Figure 3 — ControlNet communication network profile class diagram

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

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

The XML schema representing the encapsulation of a legacy ControlNet 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 ControlNet ApplicationLayers class represents the combined profiles for the upper 3 OSI layers of the ControlNet communication network integration model.

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

— ConnectionManager 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 Manager object and Message Router object are fully specified in IEC 61158-5:2003 and IEC 61158-6:2003 (Type 2).

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6.1.2.3 Transport layers

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

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

— CNPhysicalLayer identifies the physical layer characteristics (e.g. connectors, delays);

— CNLinkLayer and ControlNetObject 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 ControlNet object is fully specified in IEC 61158-4:2003 (Type 2).

6.1.2.4 Network management

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

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

— Keeper defines the properties associated with network management;

— ControlNetScheduling defines the properties associated with allocation of scheduled transmission time;

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

NOTE The corresponding Keeper object and ControlNet Scheduling object are fully specified in IEC 61158-4:2003 (Type 2).

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