INTERNATIONAL STANDARD

ISO 15745-4

First edition
2003-11-15

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

Part 4: Reference description for Ethernet-based control systems

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

Partie 4: Description de référence pour les systèmes de contrôle fondés sur Ethernet

Reference number
ISO 15745-4:2003(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

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 part of ISO 15745 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 15745-4 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 Ethernet[1]-based control systems (ADS-net[2], FL-net[3] and EtherNet/IP™[4]). EtherNet/IP™ technology uses a profile of IEC 61158 which is specified in IEC 61784-1.

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] Ethernet is used in this document as a synonym for ISO/IEC 8802-3.

[2] ADS-net is a trade name used to describe JIS-TR B0012 (Autonomous Decentralized System network). 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 ADS-net.

[3] FL-net is a trade name used to describe JEM 1479. 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 FL-net.

[4] EtherNet/IP™ 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 EtherNet/IP™. Use of the trade name EtherNet/IP™ requires permission of either ControlNet International, Ltd. or Open DeviceNet Vendor Association, Inc.

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

Part 4: Reference description for Ethernet-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 Ethernet-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 639-2:1998, *Codes for the representation of names of languages – Part 2: Alpha-3 code*

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

ISO/IEC 7498-4:1989, *Information processing systems – Open Systems Interconnection – Basic Reference Model – Part 4: Management framework*

ISO/IEC 8802-3:2000, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*

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

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*

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

JEM 1479:2002, *Protocol specification – Factory automation control Link Network (FL-net)*

JIS-TR B0012: 2000, *Autonomous Decentralized System Network (ADS-net)*

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 768:1980, *User Datagram Protocol – Internet Engineering Task Force (IETF), Request for Comments (RFC)*

RFC 791:1981, *Internet Protocol – Internet Engineering Task Force (IETF), Request for Comments (RFC)*

RFC 793:1981, *Transmission Control Protocol – Internet Engineering Task Force (IETF), Request for Comments (RFC)*

RFC 894:1984, *A standard for the Transmission of IP Datagrams over Ethernet Networks – Internet Engineering Task Force (IETF), Request for Comments (RFC)*

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
ASCII	American Standard Code for Information Interchange
CIP™[5]	Common Industrial Protocol
EDS	Electronic Data Sheet
IAS	Industrial Automation Systems
IP	Internet Protocol (see RFC 791 and RFC 894)
MAC	Media Access Control
MCG	MultiCast Group

[5] 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.

OSI	Open System Interconnection
TCD	Transaction CoDe
TCP	Transmission Control Protocol (see RFC 793)
UDP	User Datagram Protocol (see RFC 768)
UML	Unified Modeling Language (see UML V1.4)
XML	eXtensible Markup Language (see REC-xml-20001006)

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 Ethernet-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 Ethernet 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 Ethernet-based technologies use specific legacy ASCII syntax. Hence, for backward compatibility, template definitions of any technology (Annex A to Annex C) 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 Ethernet 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
ADS-net	ADS-net
FL-net	FL-net
EtherNet/IP	EtherNet/IP
CIP	EtherNet/IP
EDS	EtherNet/IP

5.3 Technology specific profiles

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

— ADS-net (see 6.1)

— FL-net (see 6.2)

— EtherNet/IP (see 6.3)

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

6 Device and communication network profiles for Ethernet-based control systems

6.1 ADS-net

6.1.1 Device profile

6.1.1.1 General

Figure 1 shows the class structure of the ADS-net device profile.

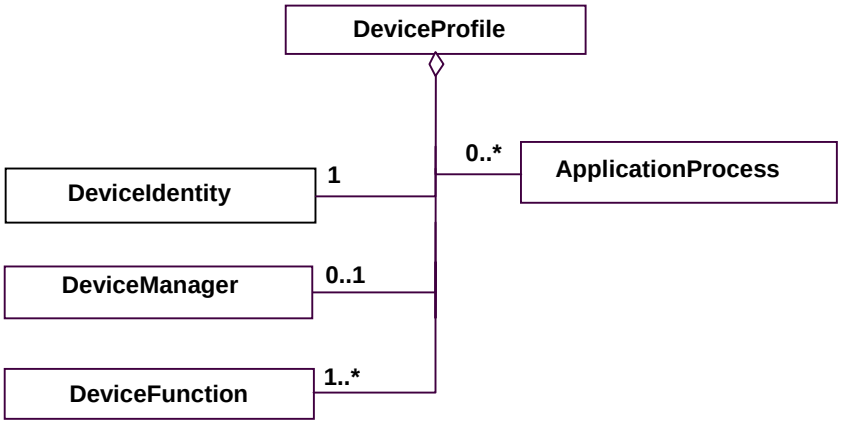

Figure 1 — ADS-net device profile class diagram

—The available formats for ADS-net device profiles are described in A.2.

The XML schema representing the ADS-net device profile template is defined in A.2.3. The file name of this XML schema shall be “ADS-net_Device_Profile.xsd”.

NOTE The ADS-net device profile class diagrams shown in Figure 1 define the main classes. These classes are further decomposed; details are defined in Annex A.

The XML schema representing the ADS-net device profile template is defined in A.2.

6.1.1.2 Device identity

The DeviceIdentity class contains attributes that enable the unique identification of the device, and supports services that enable retrieval of information from the device.

These attributes provide:

— manufacturer's identification (VendorName);

— device identification (ProductCode, ProductRevision, DeviceName).

6.1.1.3 Device manager

The DeviceManager class contains attributes and supports services that enable the monitoring and configuration of the device.

These attributes provide:

— device status (DeviceState).

6.1.1.4 Device function

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

These attributes provide:

— data field number (DFNO);

— logical node number (LNODENO);

— mode (MODE).

6.1.1.5 Application process

The ApplicationProcess class contains the attributes and support services that enable the communication control among application programs executed on ADS-net.

These attributes provide:

— producer TCD list (Producer-TCD-List);

— consumer TCD list (Consumer-TCD-List);

— priority (Priority).

6.1.2 Communication network profile

6.1.2.1 General

Figure 2 shows the class structure of the ADS-net communication network profile.

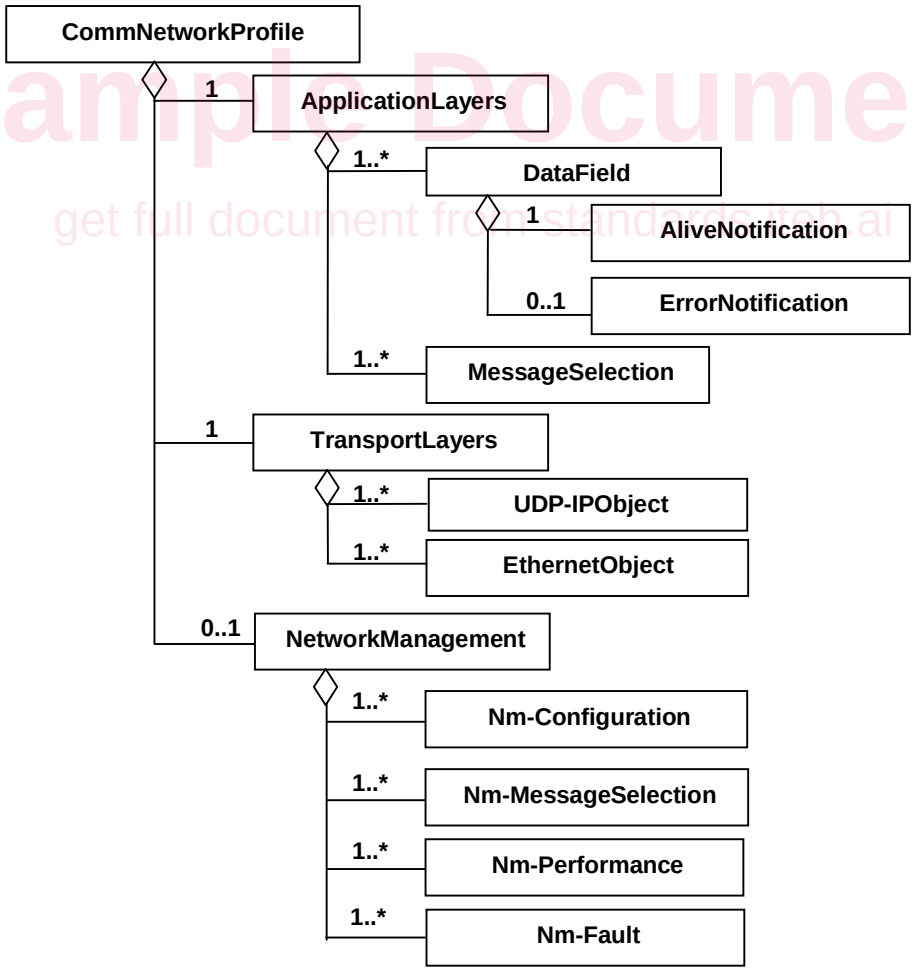

Figure 2 — ADS-net communication network profile class diagram

The available formats for ADS-net communication network profiles are described in A.3.

The XML schema representing the ADS-net communication network profile template is defined in A.3.3. The file name of this XML schema shall be “ADS-net_CommNet_Profile.xsd”.

6.1.2.2 Application layers

6.1.2.2.1 General

The ADS-net ApplicationLayers class represents the combined profiles for the upper 3 OSI layers of the ADS-net communication network integration model. It states the supported application service elements and their associated services.

Figure 3 shows the definition of the ADS-net ApplicationLayers class.

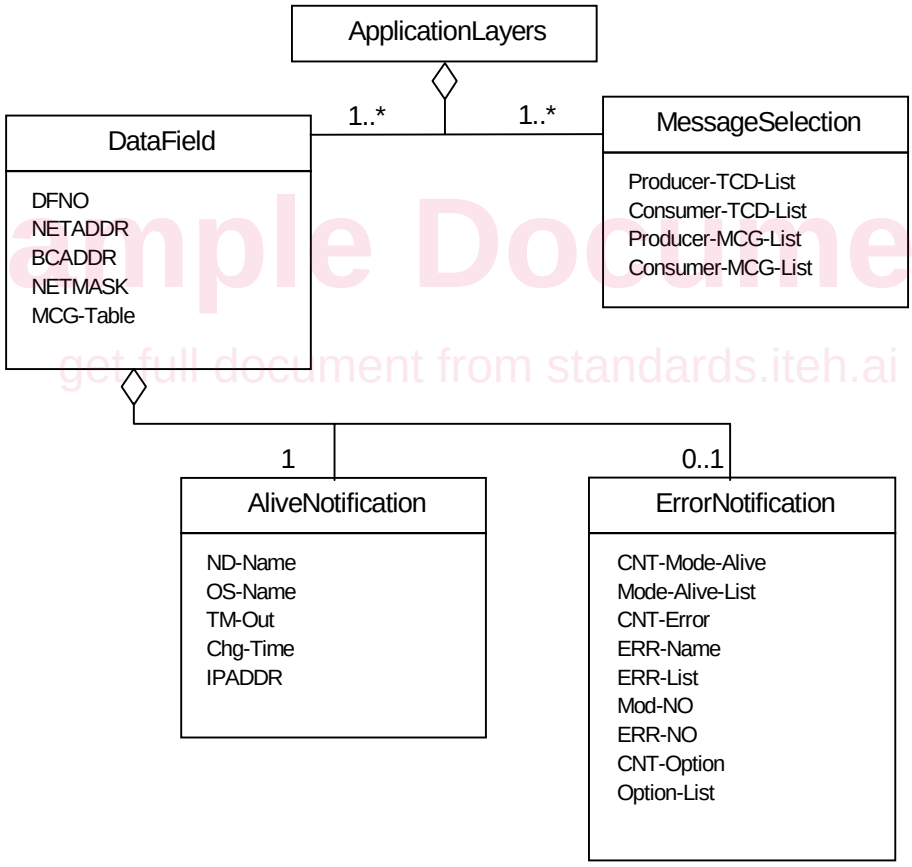

Figure 3 — ADS-net ApplicationLayers class diagram

6.1.2.2.2 DataField

6.1.2.2.2.1 General

ADS-net defines a domain named “data field” where subsystems share information by peer-to-peer message passing. Each node computer transmits messages on a multicast basis to the data field it belongs to, and the other node computers belonging to the same data field can receive the data autonomously. Multiple computers belong to a data field to send or receive data. Multicast group (MCG), a group of node computers belonging to the data field, is also introduced to localize the multicast.

DataField defines properties used to control a data field. DataField attributes provide in particular:

— data field number (DFNO);

— multicast group table (MCG-Table).

6.1.2.2.2.2 AliveNotification

A “keep alive” message is transmitted to the data field periodically to notify the status of the sender node computer to the other node computers.

AliveNotification defines the properties used to check the status of node computers. AliveNotification attributes provide in particular:

— node name (ND-Name);

— time out (TM-Out).

6.1.2.2.2.3 ErrorNotification

When a fault occurs in a node computer, the fault information is included in the “keep alive” message that is transmitted to the data field during a “keep alive” message transmission cycle. Any node computer belonging to the same data field can detect the fault (error) status.

ErrorNotification defines properties describing this fault information. ErrorNotification attributes provide in particular:

— error name (ERR-Name);

— error list (ERR-List).

6.1.2.3 MessageSelection

TCD is an identifier of a message defined uniquely in a data field. The transmitter sends a TCD-assigned message to a specified data field on a multicast basis, while each node computer belonging to the same data field autonomously selects only the relevant messages based on their TCD.

MessageSelection defines properties used for this message exchange. MessageSelection attributes provide in particular:

— producer TCD list (Producer-TCD-List);

— consumer TCD list (Consumer-TCD-List);

— producer MCG list (Producer-MCG-List);

— consumer MCG list (Consumer-MCG-List).

6.1.2.3 Transport layers

6.1.2.3.1 General

The ADS-net TransportLayers class represents the combined profiles for the lower 4 OSI layers of the communication network integration model. The TransportLayers class is divided into one or more Ethernet based objects and a UDP/IP object.

6.1.2.3.2 EthernetObject

EthernetObject defines properties of Ethernet used to implement ADS-net. EthernetObject attributes provide:

— media type (MediaType);

— communication rate (CommRate);

— indicators (Indicators);

— MAC address (MACAddress);

— error log (ErrorLog).

6.1.2.3.3 UDP-IPObject

UDP-IPObject defines properties of UDP/IP used to implement ADS-net. UDP-IPObject attributes provide.

— IP address (IPADDR);

— multicast group information (UDP-IP-MCGs);

— host name (HostName);

— error log (ErrorLog).

6.1.2.4 Network management

6.1.2.4.1 General

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

It is further divided into several classes, as shown in Figure 2.

6.1.2.4.2 Nm-Configuration

6.1.2.4.2.1 General

Nm-Configuration defines properties of network configuration related to ADS-net. Nm-Configuration attributes provide in particular:

— active data field number list (ActiveDataFieldNoList);

— active node number list (ActiveNodeNoList);

— active multicast group number list (ActiveMulticastGroupNoList).

6.1.2.4.2.2 Nm-MessageSelection

Nm-MessageSelection defines properties used for the management of message selection. Nm-MessageSelection attributes provide in particular:

— active producer TCD supported list (ActiveProducerTCDSupportedList);

— active consumer TCD supported list (ActiveConsumerTCDSupportedList).