

Australian Standard™

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

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



This Australian Standard was prepared by Committee IT-006, Information Technology for Industrial Automation and Integration. It was approved on behalf of the Council of Standards Australia on 30 March 2004 and published on 3 June 2004.

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Australian Standard™

Industrial automation systems and integration—Open systems application integration framework

Part 4: Reference description for Ethernet-based control systems

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PREFACE

This Standard was prepared by the Standards Australia Committee IT-006, Information Technology for Industrial Automation and Integration.

This Standard is identical with, and has been reproduced from, ISO 15745-4:2003, *Industrial automation systems and integration—Open systems application integration framework, Part 4: Reference description for Ethernet-based control systems*.

The objective of this Standard is to provide 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.

This Standard is Part 4 of AS ISO 15745—2004, *Industrial automation systems and integration—Open systems application integration framework*, which is published in parts as follows:

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 (this Standard)

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ISO		AS	
15745-1	Industrial automation systems and integration—Open systems application integration framework—Part 1: Generic reference description	15745.1	Industrial automation systems and integration—Open systems application integration framework, Part 1: Generic reference description

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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 Ethernet¹-based control systems (ADS-net², FL-net³ and EtherNet/IPTM⁴). EtherNet/IPTM 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/IPTM 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/IPTM. Use of the trade name EtherNet/IPTM requires permission of either ControlNet International, Ltd. or Open DeviceNet Vendor Association, Inc.

NOTES

AUSTRALIAN STANDARD

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 ^{TM5}	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 CIPTM 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 CIPTM. Use of the trade name CIPTM 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.

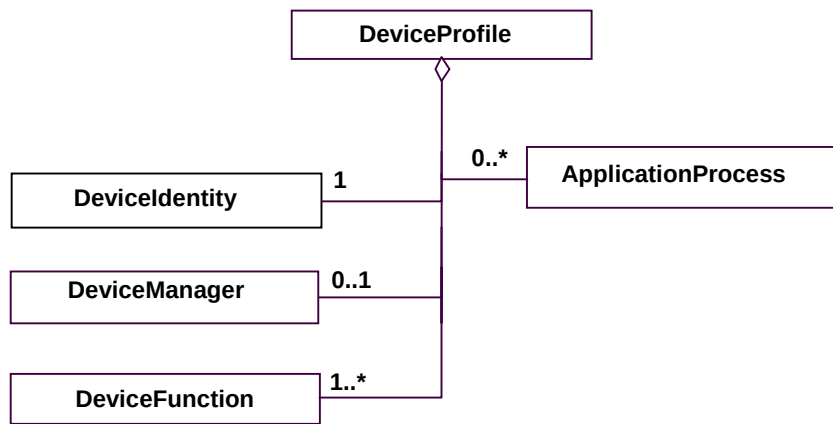


Figure 1 — ADS-net device profile class diagram

—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.

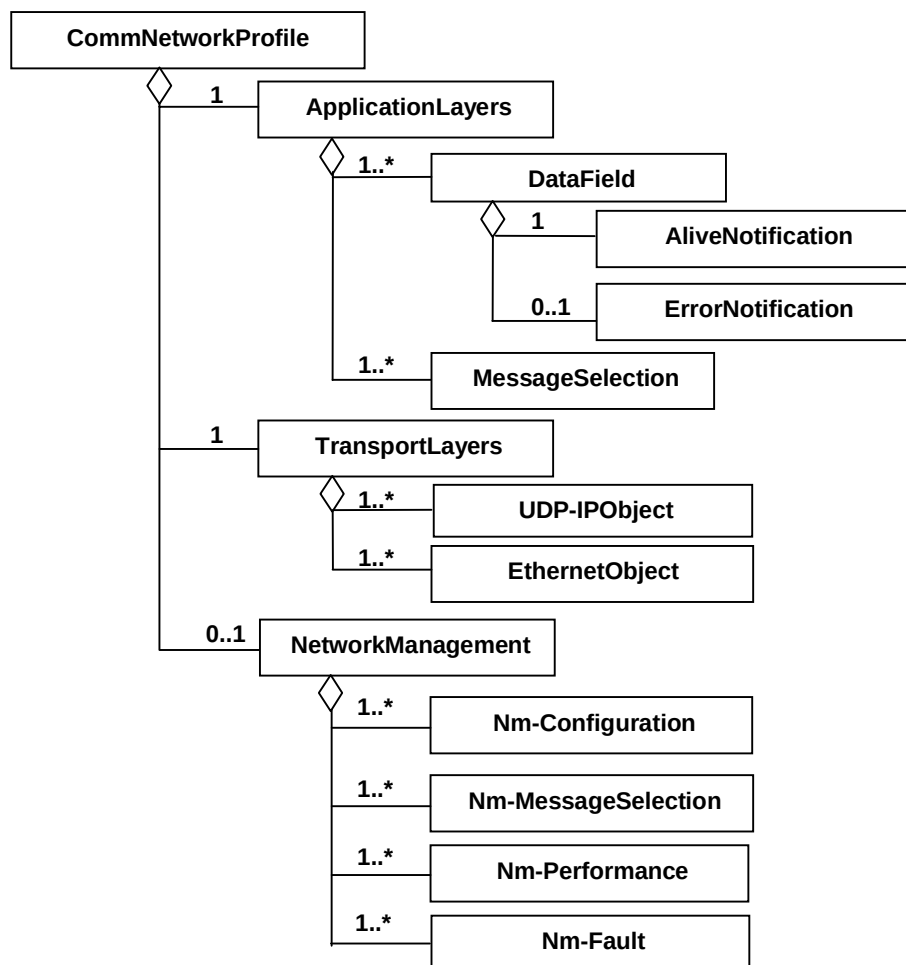


Figure 2 — ADS-net communication network profile class diagram

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.

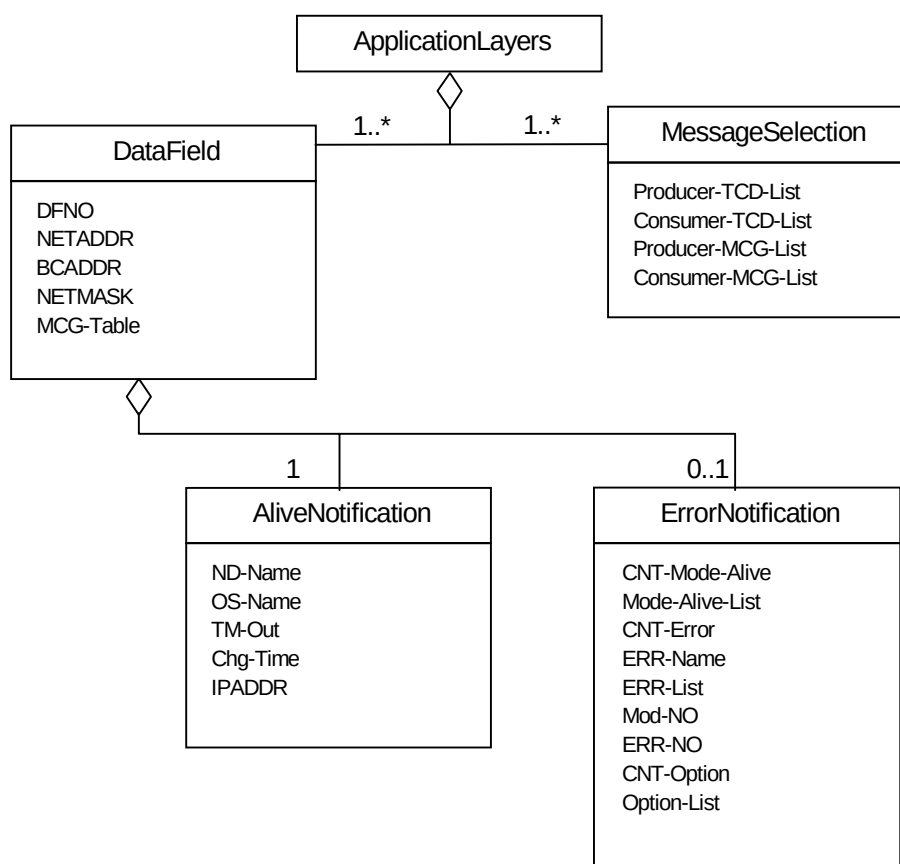


Figure 3 — ADS-net ApplicationLayers class diagram

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 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).

6.1.2.2.3 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).

6.1.2.4.2.3 Nm-Performance

Nm-Performance defines properties used for performance monitoring. Nm-Performance attributes provide:

- number of messages exchanged (MessageTransaction).

6.1.2.4.3 Nm-Fault

Nm-Fault defines properties used for fault monitoring. Nm-Fault attributes provide in particular:

- fault node list (FaultNodeList).

6.2 FL-net

6.2.1 Device profile

6.2.1.1 General

Figure 4 shows the class structure of the FL-net device profile.

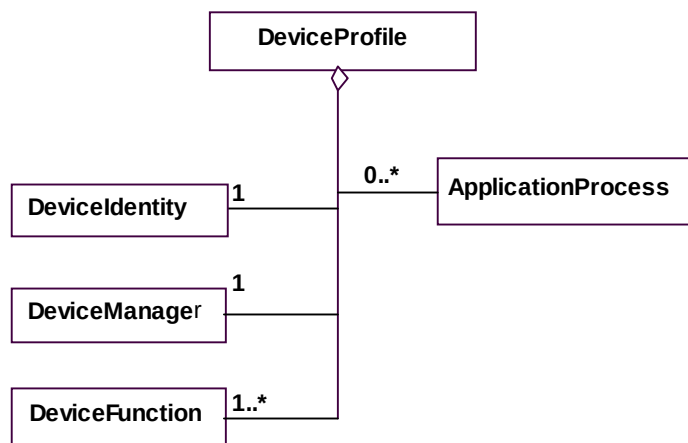


Figure 4 — FL-net device profile class diagram

The available formats for FL-net device profiles are described in B.1.

The XML schema representing the FL-net device profiles template is defined in B.1.5. The file name of this XML schema shall be "FL-net_Device_Profile.xsd".

NOTE 1 The FL-net device profile class diagrams shown in Figure 4 define the main classes. Some classes are further decomposed; details are defined in Annex B.

NOTE 2 All these classes are mapped to the same XML schema defined in B.1.5.

6.2.1.2 Device identity

The DeviceIdentity class is defined in Figure 5, and the sub-classes are described in Table 2.

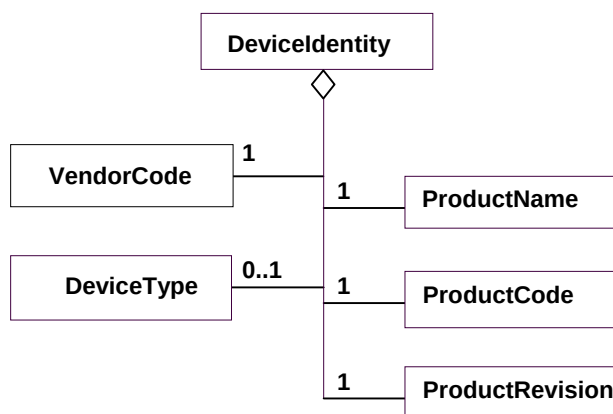


Figure 5 — FL-net DeviceIdentity class diagram

Table 2 — Elements of DeviceIdentity object

Class elements	Description
VendorCode	Code of the manufacturer or vendor of the device
ProductName	Vendor specific name of the product
ProductCode	Unique ID, identifying the product. The format is at the vendor's discretion
ProductRevision	Vendor specific revision number of the product
DeviceType	FL-net specific Device type (see Table B.1)

6.2.1.3 Device manager

6.2.1.3.1 General

Figure 6 shows the class structure of the DeviceManager object.

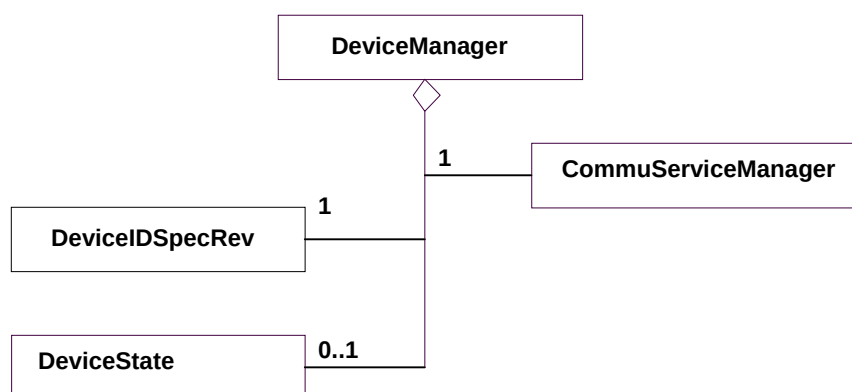


Figure 6 — FL-net DeviceManager class diagram

6.2.1.3.2 DeviceIDSpecRev

The DeviceIDSpecRev object shall describe the revision of FL-net identity object.

6.2.1.3.3 CommuServiceManager

The CommuServiceManager object shall describe the communication service, which is responsible for monitoring and configuration.

6.2.1.3.4 DeviceState

The DeviceState object shall describe the states of the device.

6.2.1.4 Device function

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

NOTE The device function class is not defined in ISO 15745-4.

6.2.1.5 Application process

The ApplicationProcess object contains attributes and supports services that correspond to the application requirement.

These attributes provide in particular:

— plant name (PlantName).

To allow specific representation of the application process, additional sub-classes and additional attributes may be defined to describe the application process.

6.2.2 Communication network profile

6.2.2.1 General

Figure 7 shows the class structure of the FL-net communication network profile.

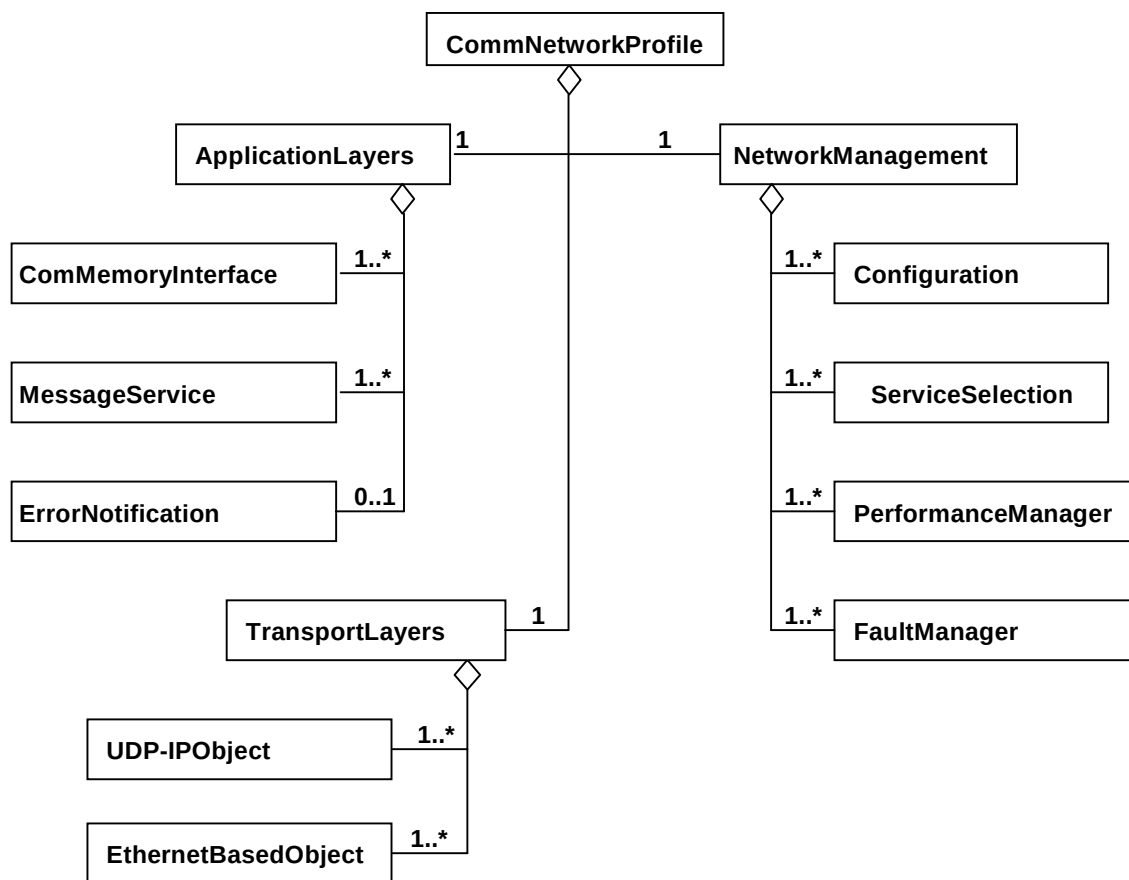


Figure 7 — FL-net communication network profile class diagram

The available formats for FL-net communication network profiles are described in B.2.

The XML schema representing the FL-net communication network profile template is defined in B.2.4.5. The file name of this XML schema shall be "FL-net_CommNet_Profile.xsd".

6.2.2.2 ApplicationLayers

6.2.2.2.1 General

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

It is further divided into several classes, as shown in Figure 7.

NOTE The ApplicationLayers object is fully specified in JEM 1479:2002.

6.2.2.2.2 ComMemoryInterface

The ComMemoryInterface object defines the properties associated with common memory interface. The elements of the ComMemoryInterface object are specified in B.2.2.1.

6.2.2.2.3 MessageService

The MessageService object defines the properties associated with message services in the device. The elements of the MessageService object are specified in B.2.2.2.

6.2.2.2.4 ErrorNotification

The ErrorNotification object defines the properties associated with error items related to the network and the device. The elements of the ErrorNotification object are specified in B.2.2.3.

6.2.2.3 TransportLayers

6.2.2.3.1 General

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

It is further divided into several classes, as shown in Figure 7.

6.2.2.3.2 EthernetBasedObject

The EthernetBasedObject object defines the properties associated with physical layer of FL-net. The elements of the EthernetBasedObject object are specified in B.2.3.1.

6.2.2.3.3 UDP-IPObject

The UDP-IPObject object defines the properties associated with data link layer configuration and monitoring. The elements of the UDP-IPObject object are specified in B.2.3.2.

6.2.2.4 NetworkManagement

6.2.2.4.1 General

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

It is further divided into several classes, as shown in Figure 7.

NOTE The NetworkManagement object is fully specified in JEM 1479:2002.

6.2.2.4.2 Configuration

The Configuration object defines the properties associated with the initial set-up and modification of the configuration. The elements of the Configuration object are specified in B.2.4.1.

6.2.2.4.3 ServiceSelection

The ServiceSelection object defines the properties associated with network communication services. The elements of the ServiceSelection object are specified in B.2.4.2.

6.2.2.4.4 PerformanceManager

The PerformanceManager object defines the properties associated with performance of data exchange in the network. The elements of the PerformanceManager object are specified in B.2.4.3.

6.2.2.4.5 FaultManager

The FaultManager object defines the properties associated with fault items of FL-net. The elements of the FaultManager object are specified in B.2.4.4.

6.3 EtherNet/IP

6.3.1 Device profile

6.3.1.1 General

Figure 8 shows the class structure of the EtherNet/IP device profile.

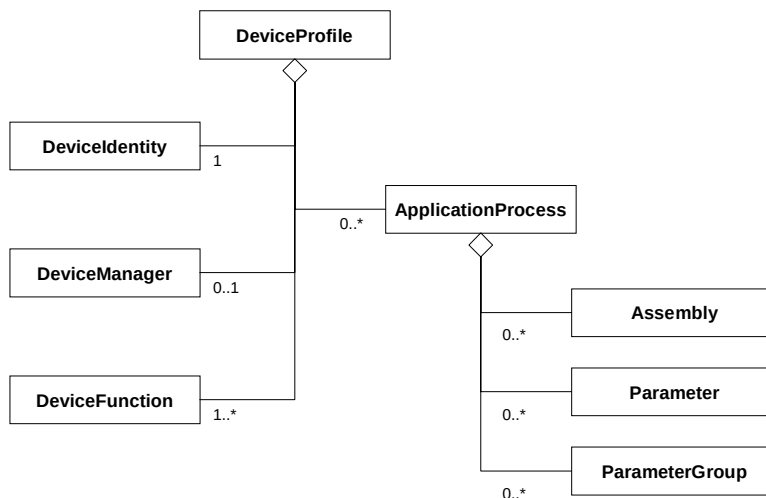


Figure 8 — EtherNet/IP device profile class diagram

The available formats for EtherNet/IP device profiles are described in C.2.

The XML schema representing the EtherNet/IP device profile template is defined in C.2.1.3.3. The file name of this XML schema shall be "CIP_Device_Profile.xsd".

NOTE The EtherNet/IP device profile class diagram shown in Figure 8 defines the main classes. These classes are further decomposed; details are defined in Annex C.

The XML schema representing the encapsulation of a legacy EtherNet/IP EDS into the ISO 15745 device profile template is defined in C.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 C.4.

6.3.1.2 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).

6.3.1.3 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 EtherNet/IP identity object;
- information on device structure (for devices integrated in a modular system).

Services allow:

- device reset;
- retrieval of DeviceManager attributes.

6.3.1.4 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 15745-4.

6.3.1.5 Application process

Figure 9 shows the class structure of the ApplicationProcess class.

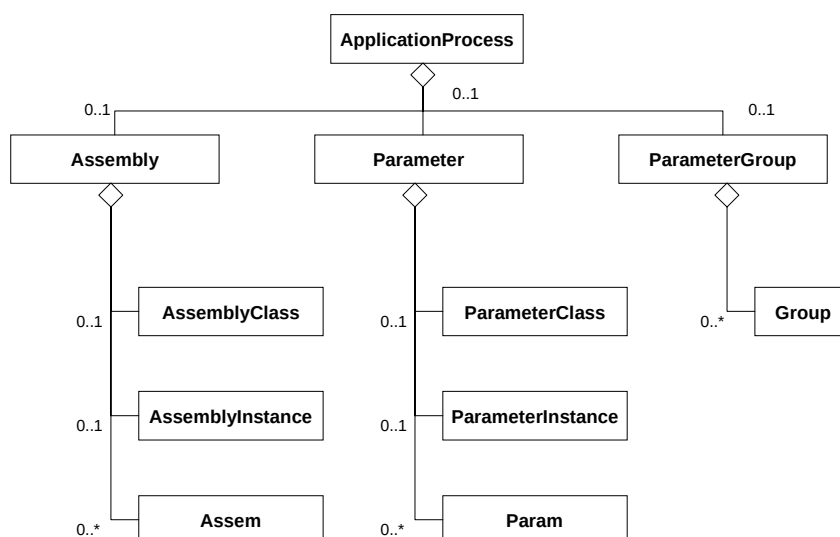


Figure 9 — EtherNet/IP ApplicationProcess class diagram

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 EtherNet/IP Assembly object and Parameter objects. The Assembly object is fully specified in IEC 61158-5:2003 and IEC 61158-6:2003 (Type 2).

6.3.2 Communication network profile

6.3.2.1 General

Figure 10 shows the class structure of the EtherNet/IP communication network profile.

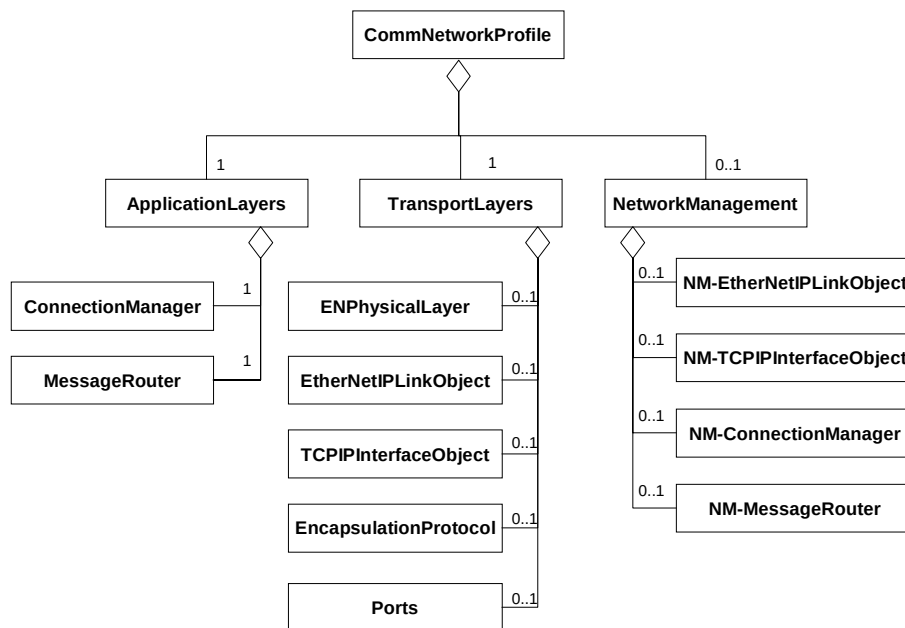


Figure 10 — EtherNet/IP communication network profile class diagram

The available formats for EtherNet/IP communication network profiles are described in C.3.

The XML schema representing the EtherNet/IP communication network profile template is defined in C.3.1.3. The file name of this XML schema shall be "ENet_CommNet_Profile.xsd".

The XML schema representing the encapsulation of a legacy EtherNet/IP EDS into the ISO 15745 communication network profile template is defined in C.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 C.4.

6.3.2.2 Application layers

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

It is further divided into several classes, as shown in Figure 10:

- 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).

6.3.2.3 Transport layers

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

It is further divided into several classes, as shown in Figure 10:

- ENPhysicalLayer identifies the physical layer characteristics;
- EtherNetIPLinkObject defines the properties associated with data link layer configuration and monitoring;
- TCPIPIInterfaceObject defines the properties associated with TCP/IP configuration and monitoring;
- EncapsulationProtocol defines the properties associated with encapsulation of application messages into TCP/IP;
- Ports identifies the device ports which are able to route messages from one link to another link.

NOTE The corresponding EtherNet Link object and TCP/IP Interface object are fully specified in IEC 61158-4:2003 (Type 2), the Encapsulation Protocol options are detailed in IEC 61158-6:2003 (Type 2).

6.3.2.4 Network management

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

It is further divided into several classes, as shown in Figure 10:

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

Annex A (normative)

ADS-net profile templates

A.1 General

The upper layers of the ADS-net are based on the Autonomous Decentralized System network (ADS-net). This protocol models all communication as messaging using producer-consumer relationships.

ADS-net provides access to all configuration data, status information, and runtime variables in a node and/or a system.

A.2 ADS-net device profile template description

A.2.1 General

The device profile XML files shall comply with the device profile XML schema as specified in A.2.3.

Contents of this XML schema are derived from the device profile class diagrams shown in 6.1.1, and extended with additional elements to allow full description of communication network requirements or capabilities.

A.2.2 Semantics of XML schema elements

A.2.2.1 DeviceIdentity

The semantics of the DeviceIdentity element are specified in Table A.1. These are used in the ADS-net run-time environment to provide information for full device identification.

Table A.1 — DeviceIdentity elements

Elements	Description and semantics
VendorName	Name of the device vendor
ProductCode	Identifier of the device in the vendor's product (maximum six characters)
ProductRevision	Revision number of the product
DeviceName	Name of the device

See Bibliography item [4] for more detail about the semantics of each attribute.

A.2.2.2 DeviceManager

The semantics of the DeviceManager-Attributes sub-elements of the DeviceManager element are specified in Table A.2. These are used in the ADS-net run-time environment.

Table A.2 — DeviceManager-Attributes elements

Elements	Description and semantics
DeviceState	Status of the device

A.2.2.3 DeviceFunction

The semantics of the DeviceFunction-Attributes sub-elements of the DeviceFunction element are specified in Table A.3. These are used in the ADS-net run-time environment.

Table A.3 — DeviceFunction-Attributes elements

Elements	Description and semantics
DFNO	Data field number (Decimal notation: 0 to 255)
LNODENO	Logical node number (Decimal notation: 0 to 4095)
MODE	Message mode (Decimal notation: 0 to 1) 0 = online mode 1 = test mode

See Bibliography item [4] for more detail about the semantics of each attribute.

A.2.2.4 ApplicationProcess

The semantics of the ApplicationProcess-Attributes sub-elements of the ApplicationProcess element are specified in Table A.4.

Table A.4 — ApplicationProcess-Attributes elements

Elements	Description and semantics
Producer-TCD-List	List of TCDs (Decimal notation: 1 to 65534) for message sent from the application process
Consumer-TCD-List	List of TCDs (Decimal notation: 1 to 65534) for message received by the application process
Priority	Priority (Decimal notation: 0 to 7) associated with a message, used both when sending and receiving the message

See Bibliography item [4] for more detail about the semantics of each attribute.

A.2.3 ADS-net_Device_Profile.xsd

```
<?xml version="1.0" encoding="UTF-8" ?>
<xsd:schema xmlns:xsd="http://www.w3.org/2001/XMLSchema">

  <xsd:annotation>
    <xsd:documentation>
      Device Profile - ISO 15745 Part 4
    </xsd:documentation>
  </xsd:annotation>

  <xsd:simpleType name="ProfileClassID_DataType">
    <xsd:restriction base="xsd:string">
      <xsd:enumeration value="AIP"/>
      <xsd:enumeration value="Process"/>
      <xsd:enumeration value="InformationExchange"/>
      <xsd:enumeration value="Resource"/>
      <xsd:enumeration value="Device"/>
      <xsd:enumeration value="CommunicationNetwork"/>
      <xsd:enumeration value="Equipment"/>
      <xsd:enumeration value="Human"/>
      <xsd:enumeration value="Material"/>
    </xsd:restriction>
  </xsd:simpleType>

  <xsd:complexType name="ISO15745Reference_DataType">
    <xsd:sequence>
      <xsd:element name="ISO15745Part" type="xsd:positiveInteger"/>
      <xsd:element name="ISO15745Edition" type="xsd:positiveInteger"/>
      <xsd:element name="ProfileTechnology" type="xsd:string"/>
    </xsd:sequence>
  </xsd:complexType>

  <xsd:simpleType name="IASInterface_DataType">
    <xsd:union>
      <xsd:simpleType>
        <xsd:restriction base="xsd:string">
          <xsd:enumeration value="CSI"/>
          <xsd:enumeration value="HCI"/>
          <xsd:enumeration value="ISI"/>
          <xsd:enumeration value="API"/>
          <xsd:enumeration value="CMI"/>
          <xsd:enumeration value="ESI"/>
          <xsd:enumeration value="FSI"/>
          <xsd:enumeration value="MTI"/>
          <xsd:enumeration value="SEI"/>
          <xsd:enumeration value="USI"/>
        </xsd:restriction>
      </xsd:simpleType>
      <xsd:simpleType>
        <xsd:restriction base="xsd:string">
          <xsd:length value="4"/>
        </xsd:restriction>
      </xsd:simpleType>
    </xsd:union>
  </xsd:simpleType>

  <xsd:element name="ISO15745Profile">
    <xsd:complexType>
      <xsd:sequence>
        <xsd:element ref="ProfileHeader"/>
        <xsd:element ref="ProfileBody"/>
      </xsd:sequence>
    </xsd:complexType>
  </xsd:element>

  <xsd:annotation>
    <xsd:documentation>
      ADS-net Device Profile Template
    </xsd:documentation>
  </xsd:annotation>

  <xsd:element name="ProfileHeader">
```

```

<xsd:complexType>
  <xsd:sequence>
    <xsd:element name="ProfileIdentification" type="xsd:string"/>
    <xsd:element name="ProfileRevision" type="xsd:string"/>
    <xsd:element name="ProfileName" type="xsd:string"/>
    <xsd:element name="ProfileSource" type="xsd:string"/>
    <xsd:element name="ProfileClassID" type="ProfileClassID_DataType"/>
    <xsd:element name="ProfileDate" type="xsd:date" minOccurs="0"/>
    <xsd:element name="AdditionalInformation" type="xsd:anyURI" minOccurs="0"
maxOccurs="unbounded"/>
    <xsd:element name="ISO15745Reference" type="ISO15745Reference_DataType"/>
    <xsd:element name="IASInterfaceType" type="IASInterface_DataType" minOccurs="0"
maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:complexType>
</xsd:element>

<xsd:element name="ProfileBody">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element ref="DeviceIdentity" minOccurs="1" maxOccurs="1"/>
      <xsd:element ref="DeviceManager" minOccurs="0" maxOccurs="1"/>
      <xsd:element ref="DeviceFunction" minOccurs="1" maxOccurs="unbounded"/>
      <xsd:element ref="ApplicationProcess" minOccurs="0" maxOccurs="unbounded"/>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>

<xsd:element name="DeviceIdentity">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element name="VendorName" type="xsd:string"/>
      <xsd:element name="ProductCode" type="xsd:string"/>
      <xsd:element name="ProductRevision" type="xsd:string"/>
      <xsd:element name="DeviceName" minOccurs="0" maxOccurs="1" type="xsd:string"/>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>

<xsd:element name="DeviceManager">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element ref="DeviceManager-Attributes" minOccurs="0" maxOccurs="1"/>
      <xsd:element ref="DeviceManager-Operations" minOccurs="0" maxOccurs="1"/>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>
<xsd:element name="DeviceManager-Attributes">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element name="DeviceState" minOccurs="1" maxOccurs="1" type="xsd:string"/>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>

<xsd:element name="DeviceManager-Operations">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element name="Get_Attribute_Single" minOccurs="0" maxOccurs="1"/>
      <xsd:element name="Set_Attribute_Single" minOccurs="0" maxOccurs="1"/>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>

<xsd:element name="DeviceFunction">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element ref="DeviceFunction-Attributes" minOccurs="1" maxOccurs="1"/>
      <xsd:element ref="DeviceFunction-Operations" minOccurs="0" maxOccurs="1"/>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>

<xsd:element name="DeviceFunction-Attributes">
  <xsd:complexType>
    <xsd:sequence>

```

```

        <xsd:element name="DFNO" minOccurs="1" maxOccurs="unbounded" type="xsd:unsignedByte"/>
        <xsd:element name="LNODENO" minOccurs="1" maxOccurs="unbounded" type="xsd:unsignedShort"/>
        <xsd:element name="MODE" minOccurs="1" maxOccurs="1" type="xsd:unsignedShort"/>
    </xsd:sequence>
</xsd:complexType>
</xsd:element>

<xsd:element name="DeviceFunction-Operations">
    <xsd:complexType>
        <xsd:sequence>
            <xsd:element name="Get-Attribute-Single" minOccurs="0" maxOccurs="1"/>
            <xsd:element name="Set-Attribute-Single" minOccurs="0" maxOccurs="1"/>
            <xsd:element name="Get-Attribute-All" minOccurs="0" maxOccurs="1"/>
            <xsd:element name="Set-Attribute-All" minOccurs="0" maxOccurs="1"/>
            <xsd:element name="Create" minOccurs="0" maxOccurs="1"/>
            <xsd:element name="Delete" minOccurs="0" maxOccurs="1"/>
        </xsd:sequence>
    </xsd:complexType>
</xsd:element>

<xsd:element name="ApplicationProcess">
    <xsd:complexType>
        <xsd:sequence>
            <xsd:element ref="ApplicationProcess-Attributes" minOccurs="0" maxOccurs="1"/>
            <xsd:element ref="ApplicationProcess-Operations" minOccurs="0" maxOccurs="1"/>
        </xsd:sequence>
    </xsd:complexType>
</xsd:element>

<xsd:element name="ApplicationProcess-Attributes">
    <xsd:complexType>
        <xsd:sequence>
            <xsd:element name="Producer-TCD-List" minOccurs="1" maxOccurs="unbounded" type="xsd:string"/>
            <xsd:element name="Consumer-TCD-List" minOccurs="1" maxOccurs="unbounded" type="xsd:string"/>
            <xsd:element name="Priority" minOccurs="1" maxOccurs="unbounded" type="xsd:unsignedShort"/>
        </xsd:sequence>
    </xsd:complexType>
</xsd:element>

<xsd:element name="ApplicationProcess-Operations">
    <xsd:complexType>
        <xsd:sequence>
            <xsd:element name="Get-Attribute-Single" minOccurs="0" maxOccurs="1"/>
            <xsd:element name="Set-Attribute-Single" minOccurs="0" maxOccurs="1"/>
            <xsd:element name="Get-Attribute-All" minOccurs="0" maxOccurs="1"/>
            <xsd:element name="Set-Attribute-All" minOccurs="0" maxOccurs="1"/>
            <xsd:element name="Create" minOccurs="0" maxOccurs="1"/>
            <xsd:element name="Delete" minOccurs="0" maxOccurs="1"/>
        </xsd:sequence>
    </xsd:complexType>
</xsd:element>
</xsd:schema>

```

A.3 ADS-net communication network profile template description

A.3.1 General

The communication network profile XML files shall comply with the communication network profile XML schema as specified in A.3.3.

Contents of this XML schema are derived from the communication network profile class diagrams shown in 6.1.2, and extended with additional elements to allow full description of communication network requirements or capabilities.

A.3.2 Semantics of XML schema elements

A.3.2.1 ApplicationLayers

A.3.2.1.1 DataField

A.3.2.1.1.1 General

This element specifies the supported instance attributes used to control a data field.

DataField correspond to a domain where subsystems (i.e. node computers or application programs) share information by peer-to-peer message exchange. The messages are uniquely identified within a data field. Node computers can share information by specifying the data field number as part of the message identifier. One data field is implemented per network address or sub-network address for communication among node computers, or implemented in memory for communication among application programs in a node computer.

A data field is uniquely identified by its Data Field Number (DFNO). A unique DFNO is assigned to each of the data fields within a system, in the range of 1 to 255. DFNO 0 is reserved for communication within the current node.

The semantics of the DataField-Attributes sub-elements of the DataField element are specified in Table A.5.

Table A.5 — DataField-Attributes elements

Elements	Description and semantics
DFNO	Data field number (Decimal notation: 0 to 255)
NETADDR	Subnet address described by the Internet standard dot format like "XXX.XXX.XXX.XXX"
BCADDR	Broadcast address described by the Internet standard dot format
NETMASK	Subnet mask described by the Internet standard dot format
MCG-Table	List of MCG numbers (Decimal notation: 0 to 255) used in this data field

See Bibliography item [4] for more detail about the semantics of each attribute.

A.3.2.1.1.2 AliveNotification

This element specifies the attributes used for health check of a node computer.

The semantics of the AliveNotification element are specified in Table A.6.

Table A.6 — AliveNotification elements

Elements	Description and semantics
ND-Name	Node name (ASCII character string up to nine characters)
OS-Name	Vendor device name (ASCII character string up to nine characters). Adherence to the following guideline is recommended: "BN_MN" BN: Identifier of the vendor (2 characters) MN: Vendor-defined device or OS name
TM-Out	Alive-signal timeout monitoring interval in seconds. The interval of time elapsed before a node is recognized as dead after it ceases to transmit an alive-signal.
Chg-Time	Time at which node state changes occurred. Use of the Greenwich Mean Time (elapsed time in seconds since 0 hour 0 minute 0 second, 1970) is recommended. Specify 0 if the Greenwich Mean Time cannot be used.
IPADDR	The IP address of LAN described by the Internet standard dot format

See Bibliography item [4] for more detail about the semantics of each attribute.

A.3.2.1.1.3 ErrorNotification

This element specifies the attributes used for fault check of a node computer.

The semantics of the ErrorNotification element are specified in Table A.7.

Table A.7 — ErrorNotification elements

Elements	Description and semantics
CNT-Mode-Alive	Number of modules reporting that they are alive
Mod-Alive-List	Status list for all modules (dead or alive)
CNT-Error	Number of reported errors
ERR-Name	Error name
ERR-List	List of error numbers
Mod-NO	Module number (1 or higher)
ERR-NO	Error number, which is uniquely identified by ERR-Name
CNT-Option	The length of optional information
Option-List	List of optional information

See Bibliography item [4] for more detail about the semantics of each attribute.

A.3.2.1.2 MessageSelection

This element specifies the attributes used for message exchange in ADS-net.

A message is uniquely identified by a Transaction Code (TCD). The transmitter sends a message associated with a TCD using a multicast transmission to a multicast group within a specified data field. The nodes within the specified multicast group accept only the messages with the relevant TCD.

The semantics of the MessageSelection-Attributes sub-elements of the MessageSelection element are specified in Table A.8.

Table A.8 — MessageSelection-Attributes elements

Elements	Description and semantics
Producer-TCD-List	List of TCDs (Decimal notation: 1 to 65534) for the messages to be sent
Consumer-TCD-List	List of TCDs (Decimal notation: 1 to 65534) for the messages to be received
Producer-MCG-List	List of MCG numbers (Decimal notation: 0 to 255) used to send messages
Consumer-MCG-List	List of MCG numbers (Decimal notation: 0 to 255) used to receive messages

See Bibliography item [4] for more detail about the semantics of each description.

A.3.2.2 TransportLayers

A.3.2.2.1 EthernetObject

This element specifies the attributes of Ethernet used for ADS-net.

The EthernetObject defines the attributes associated with data link layer configuration and monitoring.

The semantics of the EthernetObject-Attributes sub-elements of the EthernetObject element are specified in Table A.9.

Table A.9 — EthernetObject-Attributes elements

Elements	Description and semantics
MediaType	The type of Ethernet media (e.g. 10Base-T, 100Base-TX)
CommRate	Communication rate depending on the Ethernet media (e.g. 100Mbps)
Indicators	Status of the Ethernet media
MACAddress	MAC address
ErrorLog	List of errors that occurred in the physical and data link layers

A.3.2.2.2 UDP-IPObject

This element specifies the attributes of UDP/IP used for ADS-net.

The semantics of the UDP-IPObject-Attributes sub-elements of the UDP-IPObject element are specified in Table A.10.

Table A.10 — UDP-IPObject -Attributes elements

Elements	Description and semantics
IPADDR	IP address described by the Internet standard dot format
UDP-IP-MCGs	The semantics of this element are specified in Table A.11
HostName	Host name of the device corresponding to the IP address
ErrorLog	List of errors that occurred in the transport layer

Table A.11 — UDP-IP-MCGs elements

Elements	Description and semantics
McgNumber	The identification number of the multicast group (Decimal notation: 0 to 255)
PortNumber	Port number used for the multicast group

See Bibliography item [4] for more detail about the semantics of each attribute.

A.3.2.3 NetworkManagement

A.3.2.3.1 Nm-Configuration

This element specifies the attributes used for network configuration.

The semantics of the Nm-Configuration-Attributes sub-elements of the Nm-Configuration element are specified in Table A.12.

Table A.12 — Nm-Configuration -Attributes elements

Elements	Description and semantics
ActiveDataFieldNoList	List of data field numbers (Decimal notation: 0 to 255) used in the target system
ActiveNodeNoList	List of node numbers (Decimal notation: 0 to 4095) operating in the target system. This list is constructed by gathering alive message information.
ActiveMulticastGroupNoList	List of MCG numbers (Decimal notation: 0 to 255) used in the target system

See Bibliography item [4] for more detail about the semantics of each description.

A.3.2.3.2 Nm-MessageSelection

This element specifies the attributes used for message selection.

The semantics of the Nm-MessageSelection-Attributes sub-elements of the Nm-MessageSelection element are specified in Table A.13.

Table A.13 — Nm-MessageSelection-Attributes elements

Elements	Description and semantics
ActiveProducerTCDSupportedList	List of TCDs (Decimal notation: 1 to 65534) used for any messages to be sent
ActiveConsumerTCDSupportedList	List of TCDs (Decimal notation: 1 to 65534) used for any messages to be received
ActiveProducerMulticastGroupSupportedList	List of MCG numbers (Decimal notation: 0 to 255) used for any message transmission
ActiveConsumerMulticastGroupSupportedList	List of MCG numbers (Decimal notation: 0 to 255) used for any message reception

See Bibliography item [4] for more detail about the semantics of each description.

A.3.2.3.3 Nm-Performance

This element specifies the attributes used for performance monitoring.

The semantics of the Nm-Performance-Attributes sub-elements of the Nm-Performance element are specified in Table A.14.

Table A.14 — Nm-Performance-Attributes elements

Elements	Description and semantics
MessageTransaction	The number of messages sent and received by a device

A.3.2.3.4 Nm-Fault

This element specifies the attributes used for fault monitoring.

The semantics of the Nm-Fault-Attributes sub-elements of the Nm-Fault element are specified in Table A.15.

Table A.15 — Nm-Fault-Attributes elements

Elements	Description and semantics
FaultNodeList	List of the node numbers (Decimal notation: 0 to 4095), which are diagnosed as faulty
NotificationOfFaultProgram	Identifier of the faulty module detected by the alive message

See Bibliography item [4] for more detail about the semantics of each description.

A.3.3 ADS-net_CommNet_Profile.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<xsd:schema xmlns:xsd="http://www.w3.org/2001/XMLSchema">
  <xsd:annotation>
    <xsd:documentation>
      Communication Profile - ISO 15745 Part 4
    </xsd:documentation>
  </xsd:annotation>
  <xsd:simpleType name="ProfileClassID_DataType">
    <xsd:restriction base="xsd:string">
      <xsd:enumeration value="AIP"/>
      <xsd:enumeration value="Process"/>
      <xsd:enumeration value="InformationExchange"/>
      <xsd:enumeration value="Resource"/>
      <xsd:enumeration value="Device"/>
      <xsd:enumeration value="CommunicationNetwork"/>
      <xsd:enumeration value="Equipment"/>
      <xsd:enumeration value="Human"/>
      <xsd:enumeration value="Material"/>
    </xsd:restriction>
  </xsd:simpleType>
  <xsd:complexType name="ISO15745Reference_DataType">
    <xsd:sequence>
      <xsd:element name="ISO15745Part" type="xsd:positiveInteger"/>
      <xsd:element name="ISO15745Edition" type="xsd:positiveInteger"/>
      <xsd:element name="ProfileTechnology" type="xsd:string"/>
    </xsd:sequence>
  </xsd:complexType>
  <xsd:simpleType name="IASInterface_DataType">
    <xsd:union>
      <xsd:simpleType>
        <xsd:restriction base="xsd:string">
          <xsd:enumeration value="CSI"/>
          <xsd:enumeration value="HCI"/>
          <xsd:enumeration value="ISI"/>
          <xsd:enumeration value="API"/>
          <xsd:enumeration value="CMI"/>
          <xsd:enumeration value="ESI"/>
        </xsd:restriction>
      </xsd:simpleType>
    </xsd:union>
  </xsd:simpleType>
</xsd:schema>
```

```

        <xsd:enumeration value="FSI"/>
        <xsd:enumeration value="MTI"/>
        <xsd:enumeration value="SEI"/>
        <xsd:enumeration value="USI"/>
    </xsd:restriction>
</xsd:simpleType>
<xsd:simpleType>
    <xsd:restriction base="xsd:string">
        <xsd:length value="4"/>
    </xsd:restriction>
</xsd:simpleType>
</xsd:union>
</xsd:simpleType>
<xsd:element name="ISO15745Profile">
    <xsd:complexType>
        <xsd:sequence>
            <xsd:element ref="ProfileHeader"/>
            <xsd:element ref="ProfileBody"/>
        </xsd:sequence>
    </xsd:complexType>
</xsd:element>
<xsd:annotation>
    <xsd:documentation>
        ADS-net Communication Network Profile Template
    </xsd:documentation>
</xsd:annotation>
<xsd:element name="ProfileHeader">
    <xsd:complexType>
        <xsd:sequence>
            <xsd:element name="ProfileIdentification" type="xsd:string"/>
            <xsd:element name="ProfileRevision" type="xsd:string"/>
            <xsd:element name="ProfileName" type="xsd:string"/>
            <xsd:element name="ProfileSource" type="xsd:string"/>
            <xsd:element name="ProfileClassID" type="ProfileClassID_DataType"/>
            <xsd:element name="ProfileDate" type="xsd:date" minOccurs="0"/>
            <xsd:element name="AdditionalInformation" type="xsd:anyURI" minOccurs="0"
maxOccurs="unbounded"/>
            <xsd:element name="ISO15745Reference" type="ISO15745Reference_DataType"/>
            <xsd:element name="IASInterfaceType" type="IASInterface_DataType" minOccurs="0"
maxOccurs="unbounded"/>
        </xsd:sequence>
    </xsd:complexType>
</xsd:element>
<xsd:element name="ProfileBody">
    <xsd:complexType>
        <xsd:sequence>
            <xsd:element ref="ApplicationLayers"/>
            <xsd:element ref="TransportLayers"/>
            <xsd:element ref="NetworkManagement" minOccurs="0"/>
        </xsd:sequence>
    </xsd:complexType>
</xsd:element>
<xsd:element name="ApplicationLayers">
    <xsd:complexType>
        <xsd:sequence>
            <xsd:element ref="DataField" maxOccurs="unbounded"/>
            <xsd:element ref="MessageSelection" maxOccurs="unbounded"/>
        </xsd:sequence>
    </xsd:complexType>
</xsd:element>
<xsd:element name="DataField">
    <xsd:complexType>
        <xsd:sequence>
            <xsd:element ref="DataField-Attributes"/>
            <xsd:element ref="DataField-Operations" minOccurs="0"/>
            <xsd:element ref="AliveNotification"/>
            <xsd:element ref="ErrorNotification" minOccurs="0"/>
        </xsd:sequence>
    </xsd:complexType>
</xsd:element>
<xsd:element name="DataField-Attributes">
    <xsd:complexType>
        <xsd:sequence>
            <xsd:element name="DFNO" type="xsd:unsignedByte"/>
            <xsd:element name="NETADDR" type="xsd:unsignedInt"/>
            <xsd:element name="BCADDR" type="xsd:unsignedInt"/>

```

```

        <xsd:element name="NETMASK" type="xsd:unsignedInt"/>
        <xsd:element name="MCG-Table" type="xsd:string"/>
      </xsd:sequence>
    </xsd:complexType>
  </xsd:element>
  <xsd:element name="DataField-Operations">
    <xsd:complexType>
      <xsd:sequence>
        <xsd:element name="Get_Attribute_Single" minOccurs="0"/>
        <xsd:element name="Set_Attribute_Single" minOccurs="0"/>
        <xsd:element name="Get_Attribute_All" minOccurs="0"/>
        <xsd:element name="Set_Attribute_All" minOccurs="0"/>
      </xsd:sequence>
    </xsd:complexType>
  </xsd:element>
  <xsd:element name="AliveNotification">
    <xsd:complexType>
      <xsd:sequence>
        <xsd:element name="ND-Name" type="xsd:string"/>
        <xsd:element name="OS-Name" type="xsd:string"/>
        <xsd:element name="TM-Out" type="xsd:nonNegativeInteger"/>
        <xsd:element name="Chg-Time" type="xsd:nonNegativeInteger"/>
        <xsd:element name="IPADDR" type="xsd:unsignedInt"/>
      </xsd:sequence>
    </xsd:complexType>
  </xsd:element>
  <xsd:element name="ErrorNotification">
    <xsd:complexType>
      <xsd:sequence>
        <xsd:element name="CNT-Mode-Alive" type="xsd:string"/>
        <xsd:element name="Mod-Alive-List" type="xsd:string" minOccurs="0"/>
        <xsd:element name="CNT-Error" type="xsd:string"/>
        <xsd:element name="ERR-Name" type="xsd:string" minOccurs="0"/>
        <xsd:element name="ERR-List" type="xsd:string" minOccurs="0"/>
        <xsd:element name="Mod-NO" type="xsd:string" minOccurs="0"/>
        <xsd:element name="ERR-NO" type="xsd:string" minOccurs="0"/>
        <xsd:element name="CNT-Option" type="xsd:string"/>
        <xsd:element name="Option-List" type="xsd:string" minOccurs="0"/>
      </xsd:sequence>
    </xsd:complexType>
  </xsd:element>
  <xsd:element name="MessageSelection">
    <xsd:complexType>
      <xsd:sequence>
        <xsd:element ref="MessageSelection-Attributes"/>
        <xsd:element ref="MessageSelection-Operations" minOccurs="0"/>
      </xsd:sequence>
    </xsd:complexType>
  </xsd:element>
  <xsd:element name="MessageSelection-Attributes">
    <xsd:complexType>
      <xsd:sequence>
        <xsd:element name="Producer-TCD-List" type="xsd:string" minOccurs="0"/>
        <xsd:element name="Consumer-TCD-List" type="xsd:string" minOccurs="0"/>
        <xsd:element name="Producer-MCG-List" type="xsd:string" minOccurs="0"/>
        <xsd:element name="Consumer-MCG-List" type="xsd:string" minOccurs="0"/>
      </xsd:sequence>
    </xsd:complexType>
  </xsd:element>
  <xsd:element name="MessageSelection-Operations">
    <xsd:complexType>
      <xsd:sequence>
        <xsd:element name="Get_Attribute_Single" minOccurs="0"/>
        <xsd:element name="Set_Attribute_Single" minOccurs="0"/>
        <xsd:element name="Get_Attribute_All" minOccurs="0"/>
        <xsd:element name="Set_Attribute_All" minOccurs="0"/>
        <xsd:element name="Create" minOccurs="0"/>
        <xsd:element name="Delete" minOccurs="0"/>
      </xsd:sequence>
    </xsd:complexType>
  </xsd:element>
  <xsd:element name="TransportLayers">
    <xsd:complexType>
      <xsd:sequence>
        <xsd:element ref="EthernetObject" maxOccurs="unbounded"/>
        <xsd:element ref="UDP-IPObject" maxOccurs="unbounded"/>
      </xsd:sequence>
    </xsd:complexType>
  </xsd:element>

```

```

    </xsd:sequence>
  </xsd:complexType>
</xsd:element>
<xsd:element name="EthernetObject">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element ref="EthernetObject-Attributes"/>
      <xsd:element ref="EthernetObject-Operations" minOccurs="0"/>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>
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  <xsd:complexType>
    <xsd:sequence>
      <xsd:element name="MediaType" type="xsd:string"/>
      <xsd:element name="CommRate" type="xsd:unsignedInt"/>
      <xsd:element name="Indicators" type="xsd:string" minOccurs="0"/>
      <xsd:element name="MACAddress" type="xsd:string"/>
      <xsd:element name="ErrorLog" type="xsd:string" minOccurs="0"/>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>
<xsd:element name="EthernetObject-Operations">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element name="Get-Attribute-Single" minOccurs="0"/>
      <xsd:element name="Set-Attribute-Single" minOccurs="0"/>
      <xsd:element name="Get_Attribute_All" minOccurs="0"/>
      <xsd:element name="Set_Attribute_All" minOccurs="0"/>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>
<xsd:element name="UDP-IPObject">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element ref="UDP-IPObject-Attributes"/>
      <xsd:element ref="UDP-IPObject-Operations" minOccurs="0"/>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>
<xsd:element name="UDP-IPObject-Attributes">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element name="IPADDR" type="xsd:string"/>
      <xsd:element ref="UDP-IP-MCGs" maxOccurs="unbounded"/>
      <xsd:element name="HostName" type="xsd:string"/>
      <xsd:element name="ErrorLog" type="xsd:string" minOccurs="0"/>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>
<xsd:element name="UDP-IP-MCGs">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element name="McgNumber" type="xsd:unsignedShort"/>
      <xsd:element name="PortNumber" type="xsd:unsignedShort"/>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>
<xsd:element name="UDP-IPObject-Operations">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element name="Get-Attribute-Single" minOccurs="0"/>
      <xsd:element name="Set-Attribute-Single" minOccurs="0"/>
      <xsd:element name="Get_Attribute_All" minOccurs="0"/>
      <xsd:element name="Set_Attribute_All" minOccurs="0"/>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>
<xsd:element name="NetworkManagement">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element ref="Nm-Configuration" minOccurs="0" maxOccurs="unbounded"/>
      <xsd:element ref="Nm-MessageSelection" minOccurs="0" maxOccurs="unbounded"/>
      <xsd:element ref="Nm-Performance" minOccurs="0" maxOccurs="unbounded"/>
      <xsd:element ref="Nm-Fault" minOccurs="0" maxOccurs="unbounded"/>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>

```

```

</xsd:complexType>
</xsd:element>
<xsd:element name="Nm-Configuration">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element ref="Nm-Configuration-Attributes"/>
      <xsd:element ref="Nm-Configuration-Operations" minOccurs="0"/>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>
<xsd:element name="Nm-Configuration-Attributes">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element name="ActiveDataFieldNoList" type="xsd:string"/>
      <xsd:element name="ActiveNodeNoList" type="xsd:string"/>
      <xsd:element name="ActiveMulticastGroupNoList" type="xsd:string"/>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>
<xsd:element name="Nm-Configuration-Operations">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element name="Get-Attribute-Single" minOccurs="0"/>
      <xsd:element name="Set-Attribute-Single" minOccurs="0"/>
      <xsd:element name="Get_Attribute_All" minOccurs="0"/>
      <xsd:element name="Set_Attribute_All" minOccurs="0"/>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>
<xsd:element name="Nm-MessageSelection">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element ref="Nm-MessageSelection-Attributes"/>
      <xsd:element ref="Nm-MessageSelection-Operations" minOccurs="0"/>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>
<xsd:element name="Nm-MessageSelection-Attributes">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element name="ActiveProducerTCDSupportedList" type="xsd:string"/>
      <xsd:element name="ActiveConsumerTCDSupportedList" type="xsd:string"/>
      <xsd:element name="ActiveProducerMulticastGroupSupportedList" type="xsd:string"/>
      <xsd:element name="ActiveConsumerMulticastGroupSupportedList" type="xsd:string"/>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>
<xsd:element name="Nm-MessageSelection-Operations">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element name="Get_Attribute_Single" minOccurs="0"/>
      <xsd:element name="Set_Attribute_Single" minOccurs="0"/>
      <xsd:element name="Get_Attribute_All" minOccurs="0"/>
      <xsd:element name="Set_Attribute_All" minOccurs="0"/>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>
<xsd:element name="Nm-Performance">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element ref="Nm-Performance-Attributes" minOccurs="0"/>
      <xsd:element ref="Nm-Performance-Operations" minOccurs="0"/>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>
<xsd:element name="Nm-Performance-Attributes">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element name="MessageTransaction" type="xsd:unsignedInt"/>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>
<xsd:element name="Nm-Performance-Operations">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element name="Get-Attribute-Single" minOccurs="0"/>

```

```

        <xsd:element name="Set-Attribute-Single" minOccurs="0"/>
      </xsd:sequence>
    </xsd:complexType>
  </xsd:element>
  <xsd:element name="Nm-Fault">
    <xsd:complexType>
      <xsd:sequence>
        <xsd:element ref="Nm-Fault-Attributes" minOccurs="0"/>
        <xsd:element ref="Nm-Fault-Operations" minOccurs="0"/>
      </xsd:sequence>
    </xsd:complexType>
  </xsd:element>
  <xsd:element name="Nm-Fault-Attributes">
    <xsd:complexType>
      <xsd:sequence>
        <xsd:element name="FaultNodeList" type="xsd:string"/>
        <xsd:element name="NotificationOfFaultProgram" type="xsd:string" minOccurs="0"
maxOccurs="unbounded"/>
      </xsd:sequence>
    </xsd:complexType>
  </xsd:element>
  <xsd:element name="Nm-Fault-Operations">
    <xsd:complexType>
      <xsd:sequence>
        <xsd:element name="Get-Attribute-Single" minOccurs="0"/>
        <xsd:element name="Set-Attribute-Single" minOccurs="0"/>
        <xsd:element name="Get-Attributes-All" minOccurs="0"/>
        <xsd:element name="Set-Attributes-All" minOccurs="0"/>
      </xsd:sequence>
    </xsd:complexType>
  </xsd:element>
</xsd:schema>

```

Annex B (normative)

FL-net profile templates

B.1 Device profile template description

B.1.1 General

The device profile template XML schema defined in B.1.5 contains the mapping of the device profile class diagrams shown in 6.2.1. Besides the mapped classes and attributes, it contains additional elements to enable full description of device requirements or capabilities.

B.1.2 DeviceIdentity

This element specifies the attributes and operations of the DeviceIdentity object, together with additional information for full device identification.

Table B.1 describes the elements of the DeviceType object.

Table B.1 — Elements of DeviceType object

Elements	Description and semantics
PC	Programmable controller
NC	Numerical control unit
RC	Robot controller
computer	Personal computer, panel computer, work station
SP-*xxx*	xxx is the vendor defined device name

B.1.3 DeviceManager

B.1.3.1 General

This element specifies the attributes and operations of the DeviceManager object, together with additional information for device management.

B.1.3.2 DeviceIDSpecRev object

Table B.2 describes the elements of the DeviceIDSpecRev object as defined in 6.2.1.3.2.

Table B.2 — Elements of DeviceIDSpecRev object

Elements	Description and semantics
COMVER	Revision of the DeviceIdentity
Date	Date of identity defined