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

Part 4:
Reference description for Ethernet-based control systems

AMENDMENT 1: PROFINET profiles

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

AMENDEMENT 1: Profils pour PROFINET

Reference number
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Foreword

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

Amendment to ISO 15745-4: was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration*, Subcommittee SC 5, *Architecture, communications and integration frameworks*.

This amendment to ISO 15745-4:2003 specifies profiles for PROFINET [1)] and, as such, adds to the number of technology-specific elements and rules in ISO 15745-4 for describing both communication network profiles and communication-related aspects of device profiles, thus further extending the Application Integration Framework described in ISO 15745-1.

1) PROFINET is a trade name of PROFIBUS International (PI). 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 profile does not require use of the trade name PROFINET. Use of the trade name PROFINET requires permission of PROFIBUS International.

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

Part 4: Reference description for Ethernet-based control systems

AMENDMENT 1: PROFINET profiles

Page 1, clause 2

Add the following normative references:

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

"ISO 15745-3:2003, *Industrial automation systems and integration – Open systems application integration framework – Part 3: Reference description for IEC 61158-based control systems*

"ISO/IEC 11578:1996, *Information technology -- Open Systems Interconnection -- Remote Procedure Call (RPC)*

"REC-svg-20030114, *Scalable Vector Graphics (SVG) 1.1 Specification – W3C Recommendation 14 January 2003, available at <http://www.w3.org/TR/SVG/>*

"REC-xpath-19991116*, XML Path Language (XPath) Version 1.0 – W3C Recommendation 16 November 1999*

"RFC 1101:1989, *DNS encoding of network names and other types – Internet Engineering Task Force (IETF), Request for Comments (RFC)*

"RFC 2131:1997, *Dynamic Host Configuration Protocol – Internet Engineering Task Force (IETF), Request for Comments (RFC)*"

Page 2, clause 4

Add the following abbreviated terms:

"DAP Device Access Point

"DNS Domain Name System (see RFC 1101)

"GSD Generic Station Description

"GSDML Generic Station Description Markup Language

"ID Identification

"IO Input/Output

"PDU Protocol Data Unit

"SVG Scalable Vector Graphics (see REC-svg-20030114)

"URL Uniform Resource Locator

"UUID Universally Unique Identifier (see ISO/IEC 11578)

"W3C World Wide Web Consortium"

Page 3, subclause 5.2.2

In the second sentence of the second paragraph, replace "(Annex A to Annex C)" with "(see annexes)."

Page 4, Table 1

Add a row with the entries "GSDML" under the "ProfileTechnology name" column and "PROFINET" under the "Technology" column.

Page 4, subclause 5.3

Add a fourth list item in the first paragraph to read "— PROFINET (see 6.4)."

In the second paragraph, replace "Annex A to Annex C." with "the annexes."

Page 18

Insert the following new subclause 6.4 before Annex A.

6.4 PROFINET

6.4.1 General

NOTE In addition to the UML terminology and notation in ISO 15745-1:2003, Annex A, the following diagrams make use of the multiplicity notation (UML V1.4). The multiplicity of an attribute is displayed in squared brackets.

6.4.2 Device profile

6.4.2.1 General

Figure 11 shows the class structure of a GSDML device profile.

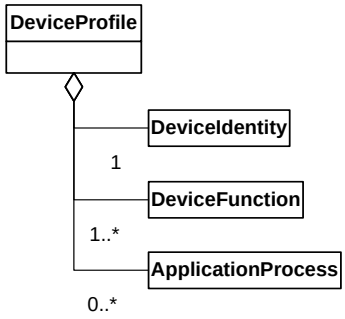


Figure 11 — GSDML device profile class diagram

The XML schema representing the GSDML device profile template is defined in D.5.2. The profile header of the GSDML device profile shall have the following content:

```
<ProfileHeader>
    <ProfileIdentification>PROFINET Device Profile</ProfileIdentification>
    <ProfileRevision>1.00</ProfileRevision>
    <ProfileName>Device Profile for PROFINET Devices</ProfileName>
    <ProfileSource>PROFIBUS Nutzerorganisation e. V. (PNO)</ProfileSource>
```

```
        <ProfileClassID>Device</ProfileClassID>
        <ISO15745Reference>
            <ISO15745Part>4</ISO15745Part>
            <ISO15745Edition>1</ISO15745Edition>
            <ProfileTechnology>GSDML</ProfileTechnology>
        </ISO15745Reference>
    </ProfileHeader>
```

6.4.2.2 Device identity

Figure 12 shows the structure of the DeviceIdentity class.

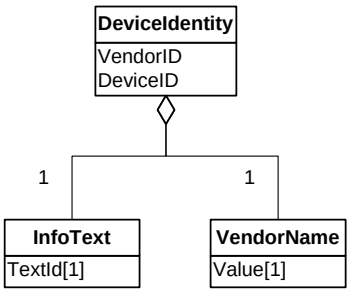


Figure 12 — DeviceIdentity class diagram

Attributes and semantics of the classes are defined in D.4.2.

6.4.2.3 Device function

Figure 13 shows the structure of the DeviceFunction class.

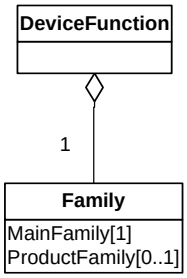


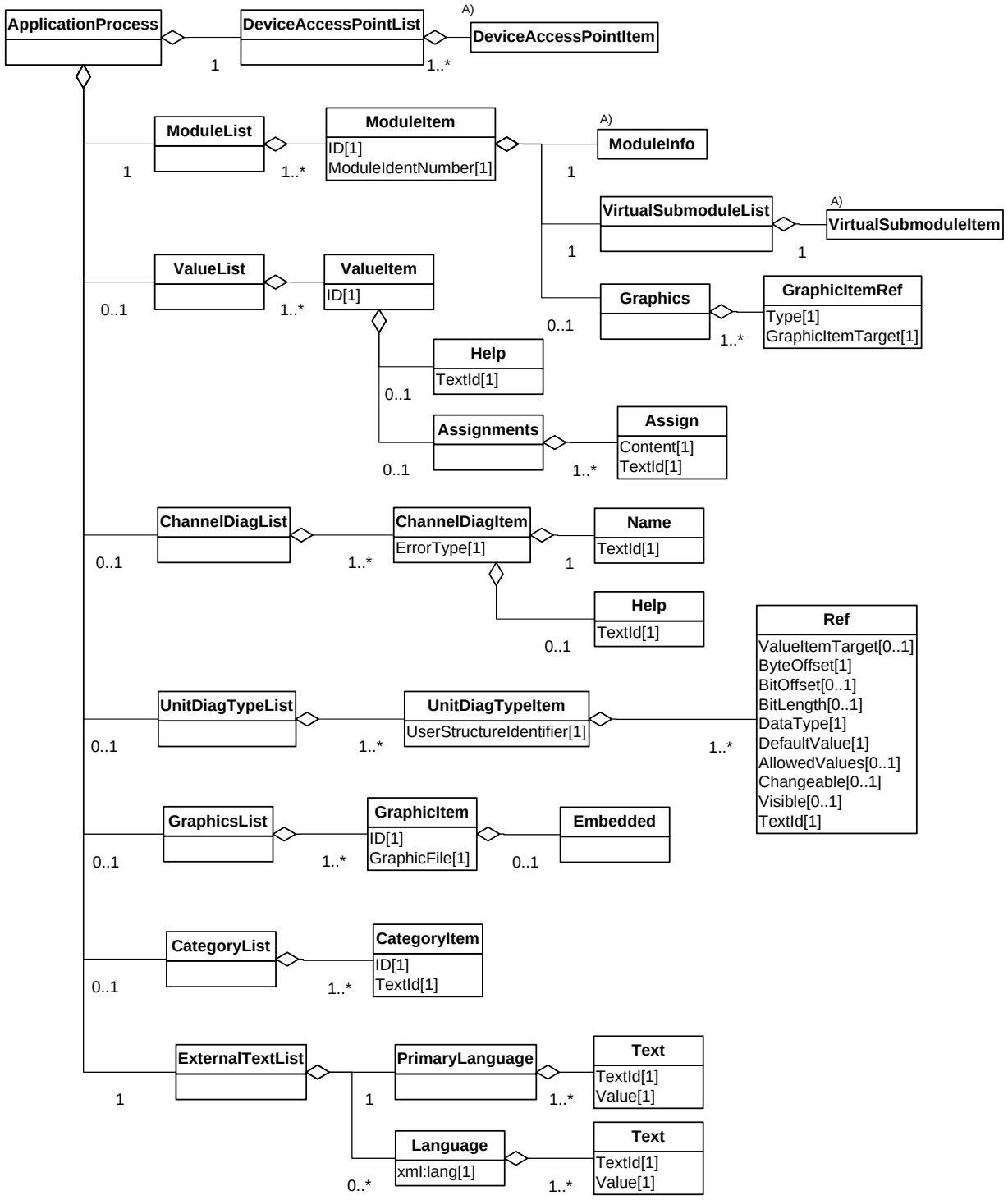
Figure 13 — DeviceFunction class diagram

Attributes and semantics of the classes are defined in D.4.3.

6.4.2.4 Application process

6.4.2.4.1 General

Figure 14 describes the structure of the ApplicationProcess element. UML classes without an attribute field are detailed in a separate diagram. Attributes and semantics of the classes are defined in D.4.4.

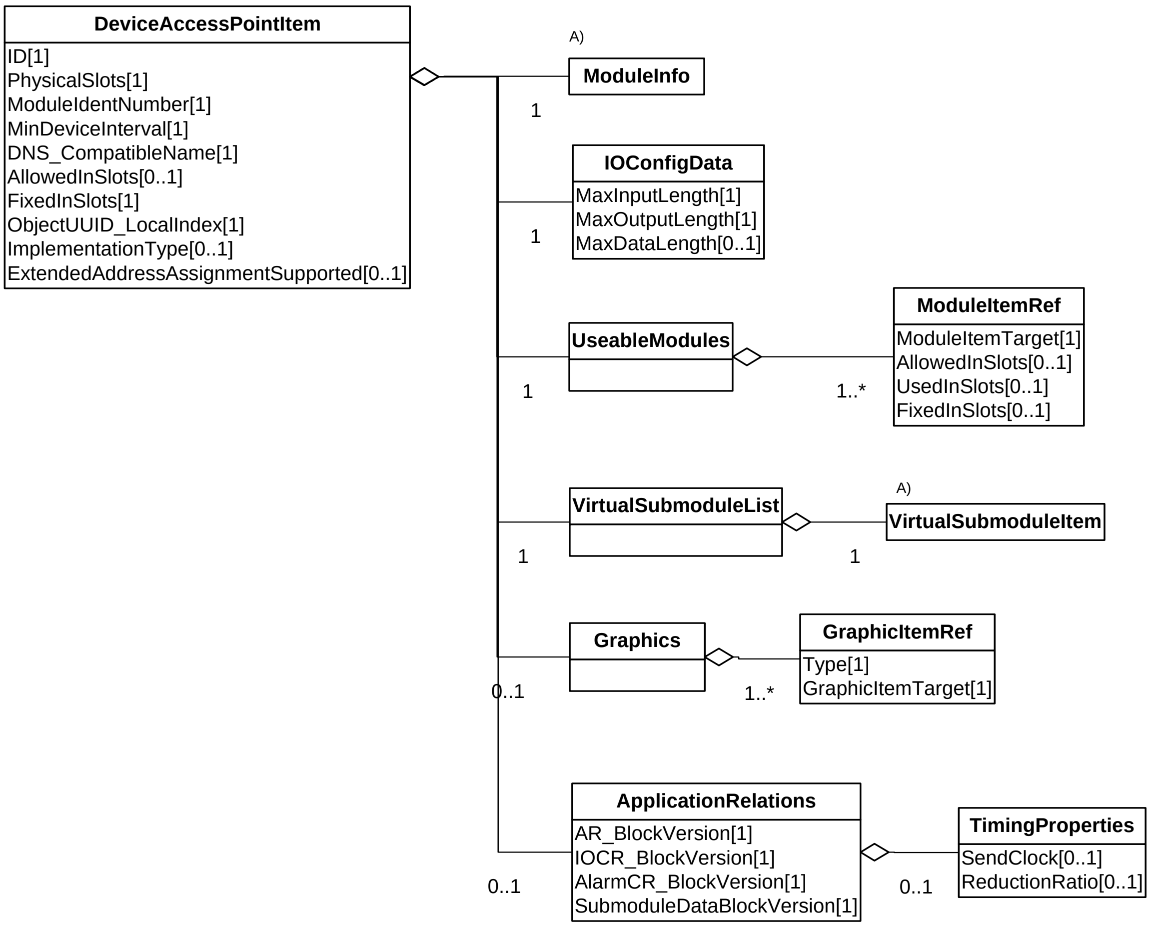


A) see subdiagram for details

Figure 14 — PROFINET ApplicationProcess class diagram

6.4.2.4.2 DeviceAccessPointItem

Figure 15 describes the structure of the DeviceAccessPointItem element. UML classes without an attribute field are explained in a separate diagram in detail. Attributes and semantics of the classes are defined in D.4.5.



A) see subdiagram for details

Figure 15 — PROFINET DeviceAccessPointItem class diagram

6.4.2.4.3 VirtualSubmoduleItem

Figure 16 describes the structure of the VirtualSubmoduleItem element. UML classes without an attribute field are explained in a separate diagram in detail. Attributes and semantics of the classes are defined in D.4.6.

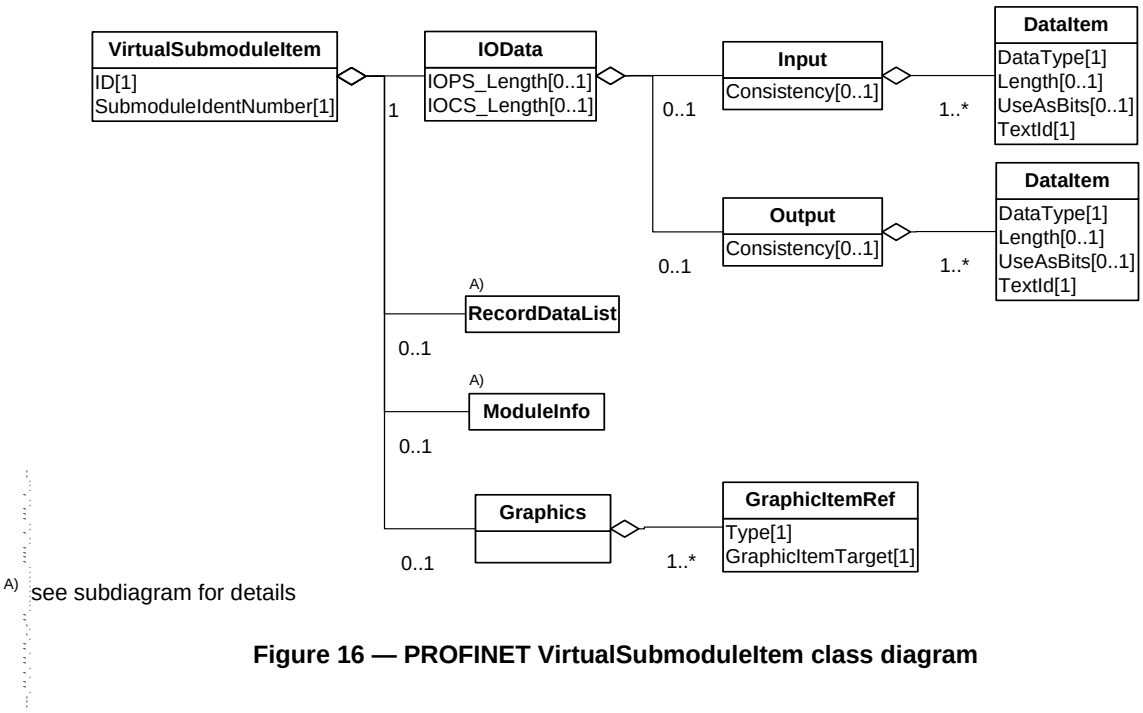


Figure 16 — PROFINET VirtualSubmoduleItem class diagram

6.4.2.4.4 RecordDataList

Figure 17 describes the structure of the RecordDataList element. Attributes and semantics of the classes are defined in D.4.7.

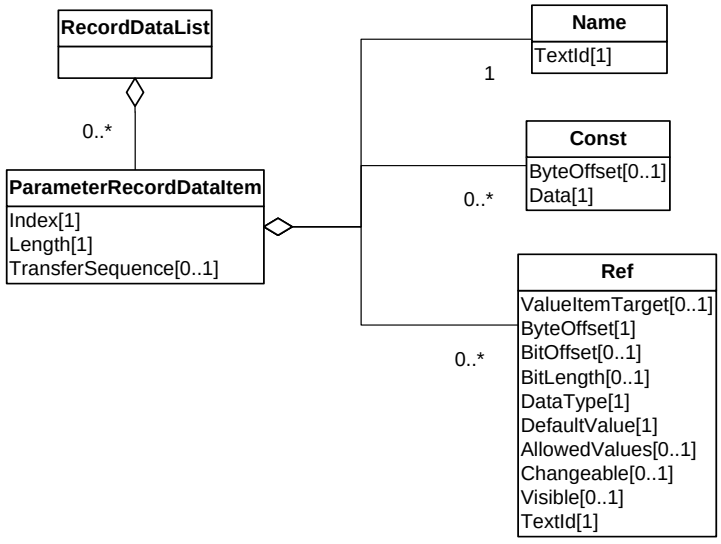


Figure 17 — PROFINET RecordDataList class diagram

6.4.2.4.5 ModuleInfo

Figure 18 describes the structure of the ModuleInfo element. Attributes and semantics of the classes are defined in D.4.8.

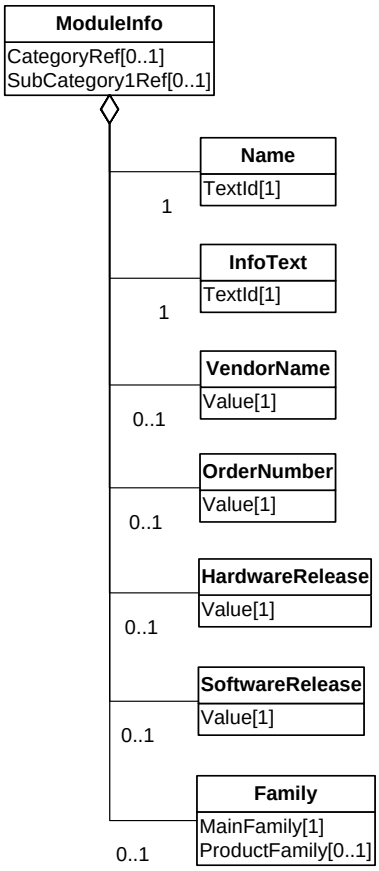


Figure 18 — PROFINET ModuleInfo class diagram

6.4.3 Communication network profile

Figure 19 shows the class structure of a GSDML communication network profile.

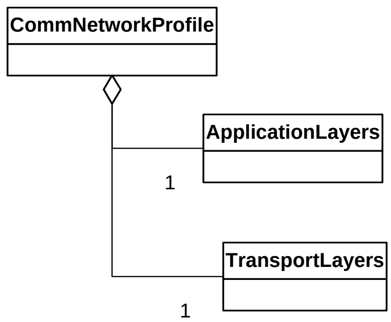


Figure 19 — PROFINET communication network profile class diagram

NOTE In GSDML the classes of the communication network profile are empty. The reason is that no options of the communication properties of a PROFINET device are provided.

The XML schema representing the GSDML communication network profile template is defined in D.5.3.

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Insert the following new Annex D before the Bibliography.

Annex D
(normative)

PROFINET profile templates

D.1 Overview

PROFINET is an Ethernet based network compliant to IEC 61784-1 (Ed.1) CP 3/3.

PROFINET uses the profile description based on ISO 15745-1. The profile technology name is GSDML (Generic Station Description Markup Language).

It is not the purpose of the GSDML format to describe technological functions or the graphical user interface of a device. For this purpose already established concepts (for example Electronic Device Description Language (EDDL) according IEC 61804-2) are recommended.

By using the GSDML a GSD (Generic Station Description) file is created. In order to distinguish from the PROFIBUS[2)] GSD format described in ISO 15745-3:2003, Annex B, the term "GSDML based file" is used in this document.

A GSDML based file can contain more than one Device Access Points (DAP). A DAP is a special module which connects the device to the network.This allows building one file for a family of devices sharing the same modules (see D.4.4.1 and D.4.5).

D.2 Data types

Table D.1 describes the data types used in the GSDML.

Regular expressions are used as defined in REC-xml-20001006.

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Table D.1 — Data types

Name	Definition Schema	Description
Boolean	http://www.w3.org/2001/XMLSchema	See (REC-xmlschema-2-20010502)
Enumeration	GSDML-DeviceProfile-v1.0.xsd	String with defined content
IdT	GSDML-Primitives-v1.0.xsd	Used for object identification. The value list shall comply with the following regular expression: (\S(.)*\S)|\S
NormalizedString	http://www.w3.org/2001/XMLSchema	See (REC-xmlschema-2-20010502)
Token	http://www.w3.org/2001/XMLSchema	See (REC-xmlschema-2-20010502)
RefIdT	GSDML-Primitives-v1.0.xsd	Used for object reference
Unsigned8	GSDML-Primitives-v1.0.xsd	Unsigned integer in range 0..255
Unsigned16	GSDML-Primitives-v1.0.xsd	Unsigned integer in range 0..65535
Unsigned32	GSDML-Primitives-v1.0.xsd	Unsigned integer in range 0.. 4294967295
ValueList	GSDML-Primitives-v1.0.xsd	Base type for a list including ranges of unsigned values. The value list shall comply with the following regular expression: ((\d+\.\.\d+)|(\d+))((\d+\.\.\d+)|(\d+))* If a range is defined, the value left from ".." shall be less than the value right from ".." (see Example 1).
SignedValueList	GSDML-Primitives-v1.0.xsd	Base type for a list including ranges of signed values. The value list shall comply with the following regular expression: ((\-?\d+\.\.\-?\d+)|(\-?\d+))((\-?\d+\.\.\-?\d+)|(\-?\d+))* If a range is defined, the value left from ".." shall be less than the value right from ".." (see Example 2).
EXAMPLE 1 Valid ValueList contents: 1 2 3 4 5 12211 0..6 5..12 0..34 36 38 EXAMPLE 2 Valid SignedValueList contents: 1 2 3 4 -12 5 12211 0..6 -5..12 0..34 36 38		

D.3 General rules

D.3.1 Version control

If a GSDML based file is already released, it is important that the identification of objects remains unchanged. Therefore the content of the attributes corresponding to the following XPath expressions (see REC-xpath-19991116) shall not be changed in a new version of a GSDML based file:

//DeviceAccessPointItem/@ID

//ModuleList/ModuleItem/@ID

//VirtualSubmoduleItem/@ID

//ValueItem/@ID

//GraphicItem/@ID

//CategoryItem/@ID

D.3.2 Rules for the name of a GSDML based file

The name of a GSDML based file shall be composed of the six fields below in the following order:

— "GSDML"

— The version ID in format Vx.y whereby “x” and “y” are unsigned numbers. The version ID refers to the ID of the GSDML Schema used.

— Vendor name

— Device family name

— Release date of the GSDML based file in format yyyymmdd

— “.xml” (file extension)

As a delimiter between the fields the dash character “-“ (ASCII 45 decimal) shall be used.

EXAMPLE "GSDML-V1.0-Lieferant-ET200X-20030818.xml"

Already released files shall not be changed without changing the filename. When building a new version of a GSDML based file, the release date shall be changed.

If more than one version of a GSDML based file is installed, the engineering system can use the release date to determine the newest version.

D.3.3 Schema location in a GSDML based file

An XML schema validator needs information about the location of the assigned schema file. Therefore the attribute xsi:schemaLocation of the ISO15745Profile root element is specified.

To use the same location for all GSDML based files, the relative path “..\xsd” shall be used for the schema files.

D.3.4 Identification of objects

Some elements in the GSDML schema can be addressed by an identifier. This identifier is an attribute with the name “ID”. See D.3.2 for the valid range of this attribute.

The Identification of objects shall be kept unique over all elements of the same category as described in the following table. (For example, all Identification of objects of Object of type “ModuleItem” shall be kept unique)

Document wide unique IDs are not necessary.

Table D.2 shows the addressable elements. The right column shows all those objects where the items of the left column are being referenced in. These references use the IDs in question as a means of addressing.

Table D.2 — Object identification

Type	Referring Elements
DeviceAccessPointItem	Reserved for future use.
ModuleItem	Attribute ModuleItemTarget of the element UseableModules/ModuleItemRef (see D.4.5.5).
VirtualSubmoduleItem	Reserved for future use.
ValueItem	Attribute ValueItemTarget of all Ref elements.
CategoryItem	Attributes CategoryRef and SubCategory1Ref of the element ModuleInfo (see D.4.8.1).
GraphicItem	Referenced from the element Graphics/GraphicItemRef (see D.4.8.10).

D.3.5 Language support

The language support is based on the concepts of XML. Language dependent strings can be kept within the GSDML based file or separated in another file. Both strategies can be combined.

The different strings are placed in the form of dictionaries inside the GSDML. Every language dependent text shall have a "TextId" attribute referencing an entry of a dictionary.

EXAMPLE 1

```
<ChannelDiagItem ErrorType="19">
  <Text TextId="ID_COMM_ERROR"/>
</ChannelDiagItem>
<ExternalTextList>
<PrimaryLanguage>
        < Text TextId="ID_COMM_ERROR" Value = "Communication error"/>
</PrimaryLanguage>
<Language xml:lang="de">
        < Text TextId="ID_COMM_ERROR" Value = "Kommunikationsfehler"/>
</Language>
<Language xml:lang="fr">
   < Text TextId="ID_COMM_ERROR" Value = "Erreur de communication"/>
</Language>
</ ExternalTextList>
```

The ExternalTextList shall have an element PrimaryLanguage. The text strings defined within the PrimaryLanguage element are used if a text string is missing in the selected language. For a GSDML based file the primary language shall be english.

The Language elements of the ExternalTextList shall have an attribute "xml:lang" for identification of the selected language. The codes for the representation of names of languages shall comply with ISO 639-1:2002.

In addition strings can reside in a external file – no changes are needed in the GSDML based file itself to support a new language. The name of the external file shall be built by the name of the corresponding GSDML based file name appending the string "-Text-" and the ISO 639-1:2002 compliant two letter code.

EXAMPLE 2 "GSDML-V1.0-Lieferant-ET200X-20030818-Text-fr.xml"

External files shall be located relative to the GSDML based file in a subdirectory. The name of the subdirectory shall be built of the two letter language code of the language of the external file. (ISO 639-1:2002)

The coding of the XML file (e.g. UTF-8) is not regulated by the GSDML. Any coding compliant with the rules of the XML specification is allowed.

D.3.6 Notation of elements and attributes for schema extensions

In GSDML schema extensions the names of elements and attributes shall be composed as follows:

— First character shall be either a decimal number ("0" to "9") or a capital letter in the range "A" to "Z".

— The following characters shall be in the range "0" to "9" or "a" to "z". Capital letters in the Range "A" to "Z" can be used in order to improve the readability.

— Abbreviations shall be used in capital form followed by an "_" character when one or more characters are following.

— The first character after the "_" character shall be either a decimal number ("0" to "9") or a capital letter in the range "A" to "Z

NOTE In GSD up to revision 5 the "_" character is often used to separate parts of keywords in order to make the keywords more readable. Sometimes upper and lower case letters were used for the same purpose.

D.4 Element description

D.4.1 General

Regular expressions are used as defined in REC-xml-20001006.

D.4.2 Device identity related elements

D.4.2.1 DeviceIdentity

Contains general information about a device. Each element shall contain attributes as shown in Table D.3

Table D.3 — Attributes of element DeviceIdentity

Name	Type	Use	Description
VendorID	NormalizedString	Required	Contains the vendor specific part of the DeviceIdentNumber. The value shall comply with the following regular expression: 0x[0-9,a-f,A-F]{1,4}. The VendorID is assigned by vendor association. Manufacturers of devices have to apply for the VendorID at the appropriate vendor association. For PROFINET the responsible association to assign a unique VendorID is the tradename owner.
DeviceID	NormalizedString	Required	Contains the device specific part of the DeviceIdentNumber. The DeviceID is a unique ID for all devices of a vendor. The vendor has to keep this ID unique. The value shall comply with the following regular expression: 0x[0-9,a-f,A-F]{1,4}.

D.4.2.2 DeviceIdentity/InfoText

Contains human readable additional text information about a device.

Use: Required.

Each element shall contain at least one attribute out of Table D.4.

Table D.4 — Attribute of element InfoText

Name	Type	Use	Description
TextId	Token	Required	Contains the ID of a text as a reference into the ExternalTextList (see D.4.4.24).

D.4.2.3 DeviceIdentity/VendorName

Contains the name of the device vendor.

Use: Required

Each element shall contain the attribute as shown in Table D.5.

Table D.5 — Attribute of element VendorName

Name	Type	Use	Description
Value	Token	Required	Contains the name of the device vendor.

D.4.3 Device function related elements

D.4.3.1 DeviceFunction

The DeviceFunction element shall contain the element "Family".

Use: Required

Attributes: None

D.4.3.2 DeviceFunction/Family

The device shall be assigned to a function class. In addition to the main family, a device can be assigned to a vendor specific product family.

Each element shall contain at least one attribute out of Table D.6.

Table D.6 — Attributes of element Family

Name	Type	Use	Description
MainFamily	Enumeration	Required	Contains the assignment to a function class. One of the following values are allowed: 0: “General” 1: “Drives” 2: “Switching devices” 3: “I/O” 4: “Valves” 5: “Controllers” 6: “HMI” 7: “Encoders” 8: “NC/RC” 9: “Gateway” 10: “Programmable Logic Controllers” 11: “Ident systems” 12: “PROFIBUS PA Profile”
ProductFamily	xsd:string	Optional	Contains the vendor specific assigment of the device to a product family.

D.4.4 Application process related elements

D.4.4.1 DeviceAccessPointList

GSDML shall contain information about one or more different access points of the same family. This element contains the list of specified DAP.

Use: Required

Attributes: none

D.4.4.2 ModuleList

This list contains all modules that are described within this GSDML based file.

Use: Required

Attributes: none

D.4.4.3 ModuleList/ModuleItem

This element contains subelements to describe the properties of a module.

Use: One or more

Each element shall contain attributes as shown in Table D.7.

Table D.7 — Attributes of element ModuleItem

Name	Type	Use	Description
ID	IdT	Required	Contains the Unique ID to be referenced by the element UseableModules/ModuleItemRef (see D.4.5.5). To be upward compatible from GSD, see ISO 15745-3:2003, Annex B, the Value of the ID should be the same as the parameter Module_Reference of the keyword Module in GSD, see ISO 15745-3:2003, Annex B.
ModuleIdentNumber	NormalizedString	Required	Contains the Module Ident Number of the module. The value shall comply with the following regular expression: 0x[0-9,a-f,A-F]{1,8}

D.4.4.4 ModuleList/ModuleItem/ModuleInfo

See D.4.7.

D.4.4.5 ModuleList/ModuleItem/VirtualSubmoduleList

See D.4.6.

D.4.4.6 ModuleList/ModuleItem/Graphics

See D.4.7.

D.4.4.7 ValueList

The ValueList element contains elements for the assignment of values to text strings.

See D.4.7.4 for an example of the ValueList.

Use: Optional

Attributes: None

D.4.4.8 ValueList/ValueItem

The ValueItem element groups all value objects and can be referenced from the “UserDataItem/Data” element.

Use: One or more

Each element shall contain attributes as shown in Table D.8.

Table D.8 — Attribute of element ValueItem

Name	Type	Use	Description
ID	IdT	Required	Contains the ID of the ValueItem element to be referenced from the attribute TextTarget of the element Ref.

D.4.4.9 ValueList/ValueItem/Help

The Help element contains additional help information about the ValueItem parameter.

Use: Optional.

Each element shall contain at least one attribute out of Table D.9

Table D.9 — Attribute of element Help

Name	Type	Use	Description
TextId	Token	Required	Contains the ID of a text as a reference into the ExternalTextList (see D.4.4.24).

D.4.4.10 ValueList/ValueItem/Assignments

This element contains an unlimited number of "Assign" elements.

Use: Optional.

Attributes: None.

D.4.4.11 ValueList/ValueItem/Assignments/Assign

The Assign element contains the assignment between the content of a parameter and the textual representation.

Use: One or more

Each element shall contain attributes as shown in Table D.10.

Table D.10 — Attributes of element Assign

Name	Type	Use	Description
Content	NormalizedString	Required	Contains the value to assign to a text reference. The value shall comply with the following regular expression: \-?[\d+]{1,20} Within an element Assignments the attribute Content of all child elements Assign shall be unique.
TextId	Token	Required	Contains the ID of the language dependent text in the ExternalTextList (see D.4.4.24). Within an element Assignments the attribute TextId of all child elements Assign shall be unique.

D.4.4.12 ChannelDiagList

Specifies a list of - channel type specific - error texts.

NOTE Used for help information.

Use: Optional

Attributes: None

D.4.4.13 ChannelDiagList/ChannelDiagItem

A ChannelDiagItem contains attributes to specify the error type of a specific channel.

Use: One or more

Each element shall contain attributes as shown in Table D.11.

Table D.11 — Attributes of element ChannelDiagItem

Name	Type	Use	Description
ErrorType	Unsigned16	Required	Contains the error type where the diagnostic text definitions can be assigned.

D.4.4.14 ChannelDiagList/ChannelDiagItem/Name

Contains the language dependent text information.

Use: Required

Each element shall contain attributes as shown in Table D.12.

Table D.12 — Attribute of element Name

Name	Type	Use	Description
TextId	Token	Required	Contains the ID of a text as a reference into the ExternalTextList (see D.4.4.24).

D.4.4.15 ChannelDiagList/ChannelDiagItem/Help

Contains the language dependent help information.

Use: Optional

Each element shall contain attributes as shown in Table D.13.

Table D.13 — Attribute of element Help

Name	Type	Use	Description
TextId	Token	Required	Contains the ID of a text as a reference into the ExternalTextList (see D.4.4.24).

D.4.4.16 UnitDiagTypeList

The UnitDiagTypeList assigns diagnostic values to manufacturer specific status and error messages.

Use: Optional

Attributes: None

D.4.4.17 UnitDiagTypeList/UnitDiagTypeItem

Use: One or more

Each element shall contain attributes as shown in Table D.14.

Table D.14 — Attributes of element UnitDiagTypeItem

Name	Type	Use	Description
UserStructureIdentifier	Unsigned16	Required	Describes the User Structure Identifier of the alarm request block. The UserStructureIdentifier shall be in the range from "0" to "32767". Within the UnitDiagTypeList (see D.4.4.16) the UserStructureIdentifier shall be unique.

D.4.4.18 UnitDiagTypeList/UnitDiagTypeItem/Ref

The Ref element contains information about a diagnostic data item within an alarm data object.

This element shall have the same attributes as defined in D.4.7.4.

The “ByteOffset” attribute of this element refers to the “additional alarm info” block of an alarm request PDU - the header information is not included.

D.4.4.19 GraphicsList

This element contains a list of GraphicItems (see D.4.4.20).

Use: Optional

Attributes: None

D.4.4.20 GraphicsList/GraphicItem

A GraphicItem carries the information for the symbolic representation of a Device, Module, or Submodule.

Use: One or more

Each element shall contain attributes as shown in Table D.15.

Table D.15 — Attributes of element GraphicItem

Name	Type	Use	Description
ID	IdT	Required	Contains the ID of the GraphicItem element to be referenced from the element Graphics/GraphicItemRef (see D.4.8.10).
GraphicFile	String	Required	Contains the file name without file extension. The format depends on the type of the GraphicItem which is defined by the attribute Type of the element GraphicItemRef.

D.4.4.21 GraphicsList/GraphicItem/Embedded

This element is used to describe the graphical information inside the GSDML based file in SVG format (see REC-svg-20030114).

NOTE Scaleable Vector Graphics (SVG) is a language for describing two-dimensional vector and mixed vector/raster graphics in XML.

Use: Optional

Attributes: None

D.4.4.22 CategoryList

This element contains a list of CategoryItem (see D.4.4.23).

NOTE 1 GSDML allows building of module and submodule categories. These categories can be used to group the modules and submodules within a catalog of an engineering tool. For example all analog input modules can be placed in one section of the catalog. This makes it easier to find the required module for the user or the engineering tool.

NOTE 2 Assigning module does not impact the runtime characteristics of a module or submodule.

Use: Optional

Attributes: None

D.4.4.23 CategoryList/CategoryItem

A CategoryItem defines the information within a single category.

Use: One or more

Each element shall contain attributes as shown in Table D.16.

Table D.16 — Attributes of element CategoryItem

Name	Type	Use	Description
ID	IdT	Required	Contains the ID of the CategoryItem element to be referenced from the attribute CategoryRef or SubCategory1Ref of the element ModuleInfo (see D.4.8.1).
TextId	Token	Required	Contains the ID of a text as a reference into the ExternalTextList (see D.4.4.24).

D.4.4.24 ExternalTextList

The ExternalTextList contains language dependent text strings.

Use: Required

Attributes: none

D.4.4.25 ExternalTextList/PrimaryLanguage

The PrimaryLanguage element contains the text definitions of the primary language which shall be used, if a text in the selected language is not available. For GSDML the primary language is english.

Use: Required

Attributes: none

D.4.4.26 ExternalTextList/PrimaryLanguage/Text

The PrimaryLanguage element

Use: Required

Attributes: See Table D.17.

Table D.17 — Attributes of element Text

Name	Type	Use	Description
TextId	xsd:string	Required	Contains the unique ID for referencing a text. The TextId shall be kept unique within the parent element PrimaryLanguage or Language
Value	xsd:string	Required	Contains the language dependent text.

D.4.4.27 ExternalTextList/Language

The Language element contains the text definitions of the specified language.

Use: One for each language.

Attributes: See Table D.18.

Table D.18 — Attributes of element Language

Name	Type	Use	Description
xml:lang	xsd:language	Required	Specifies the language of the text in subelement Text/@Value

D.4.4.28 ExternalTextList/Language/Text

The Language element.

Use: Required

Attributes: See Table D.17.

D.4.5 DeviceAccessPoint related elements

D.4.5.1 DeviceAccessPointItem

This element describes the characteristics of a DAP.

Use: One for each DAP.

Each element shall contain attributes as shown in Table D.19.

Table D.19 — Attributes of element DeviceAccessPointItem

Name	Type	Use	Description
ID	ID	Required	Contains the ID of the element
PhysicalSlots	ValueList	Required	This list describes which slots are supported by the DAP. The Slotnumber of the DAP itself shall be part of the list.
ModuleIdentNumber	NormalizedString	Required	Contains the Module Ident Number of the module. The value shall comply with the following regular expression: 0x[0-9,a-f,A-F]{1,8}
MinDeviceInterval	Unsigned16	Required	This time specifies the minimum interval for sending cyclic IO data. Basic clock tick is 31,25 microseconds. The value of this element contains the multiplier of the basic clock tick (see Example)
ImplementationType	NormalizedString	Optional	Contains a description of the standard implementation in the DAP for example, standard software, controller or ASIC (Application Specific Integrated Circuit) solution.
DNS_CompatibleName	NormalizedString	Required	Describes default name of a device compliant with the Domain Name System (DNS) rules according to RFC 1101 (see Note)
ExtendedAddressAssignmentSupported	Boolean	Optional	In PROFINET IO each IO Device shall implement the Discovery and Configuration protocol (DCP) for assignment of the IP addresses. If the DAP supports another way of IP address assignment like Dynamic Host Configuration Protocol (DHCP) according RFC 2131, this attribute has to be set to “true”. Default: “false”
AllowedInSlots	ValueList	Optional	Defines,which slots the DAP can be placed in. If not defined, the DAP cannot be placed into other slots as defined in attribute "FixedInSlots"
FixedInSlots	ValueList	Required	Specifies the slot number of the DAP when the device is configured in the engineering tool. For a non redundant DAP, only one slot number is allowed in the list. It is recommended to use "0" as slotnumber. If the attribute "AllowedInSlots" is used, the slots defined in "FixedInSlots" shall be a subset of the slots defined by the attribute "AllowedInSlots".
ObjectUUID_LocalIndex	Unsigned16	Required	Specifies the Instance field of the Object UUID.
EXAMPLE MinDeviceInterval =32 means that the device is able to send/receive data every millisecond.			
NOTE Attribute DNS_CompatibleName can be used by the engineering system to build a unique name of station.			

D.4.5.2 ModuleInfo

See D.4.8.1.

D.4.5.3 IOConfigData

This element contains information about the quantity of IO data.

Use: Required

Each element shall contain attributes as shown in Table D.20.

Table D.20 — Attributes of element IOConfigData

Name	Type	Use	Description
MaxInputLength	Unsigned 16	Required	Contains the maximum length of the data in octets which can be transferred from the IO Device to the IO Controller. This length is defined by the sum of the input data of all used submodules, the corresponding IO producer status and the IO consumer status of the used output submodules.
MaxOutputLength	Unsigned 16	Required	Contains the maximum length of the data in octets which can be transferred from the IO Controller to the IO Device. This length is defined by the sum of the output data of all used submodules, the corresponding IO producer status and the IO consumer status of the used input submodules.
MaxDataLength	Unsigned 16	Optional	Contains the maximum length of the output and input data in octets. MaxDataLength shall not be less than the highest value of MaxInputLength or MaxOutputLength. It shall not be greater than the sum of MaxInputLength and MaxOutputLength. If this keyword is not provided, the maximum length is the sum of MaxInputLength and MaxOutputLength.

D.4.5.4 UseableModules

The UseableModules element contains a list of module references referring to modules of the element ModuleList. Only modules within this list are compatible with the DAP.

An engineering tool shall not be able to configure other modules for this DAP.

Use: Required

Attributes: None

D.4.5.5 UseableModules/ModuleItemRef

This element references a module of the ModuleList being compatible with a DAP.

Use: One or more

Each element shall contain attributes as shown in Table D.21.

Table D.21 — Attributes of element ModuleItemRef

Name	Type	Use	Description
ModuleItemTarget	RefIdT	Required	References an element ModuleList/ModuleItem (see D.4.4.3).
AllowedInSlots	ValueList	Optional	Defines in which slots the module can be placed. If this attribute is not defined, the module can be placed into all slots.
UsedInSlots	ValueList	Optional	Defines in which slots the module is placed by default. Those built-in modules can be removed with an engineering tool. If the attribute AllowedInSlots is used, the slots defined in UsedInSlots shall be a subset of the slots defined by the attribute AllowedInSlots.
FixedInSlots	ValueList	Optional	Defines in which slots the module is placed by default. Those built-in modules cannot be removed with an engineering tool. If the attribute AllowedInSlots is used, the slots defined in FixedInSlots shall be a subset of the slots defined by the attribute AllowedInSlots.

D.4.5.6 VirtualSubmoduleList

This element contains a list of VirtualSubmoduleItem (see D.4.6.1).

Use: Required

Attributes: None

D.4.5.7 VirtualSubmoduleList/VirtualSubmoduleItem

See D.4.6.1.

D.4.5.8 Graphics

See D.4.7.

D.4.5.9 Graphics/GraphicItemRef

See D.4.7.

D.4.5.10 ApplicationRelations

This element contains information about the application relations implemented in an IO Device.

The VersionInformation attributes are needed to check, if the structure of the connect PDU (iPNIO_D_Connect-REQ-PDU) complies with the functionality of an IO Device. The engineering tool has to fill in the version information into the connect PDU with this attributes.

Use: Optional

Each element shall contain attributes as shown in Table D.22.

Table D.22 — Attributes of element ApplicationRelations

Name	Type	Use	Description
AR_BlockVersion	Unsigned 16	Required	Contains the version information about the AR block.
IOCR_BlockVersion	Unsigned 16	Required	Contains the version information about the IO communication relationship (CR) block, called CR block.
AlarmCR_BlockVersion	Unsigned 16	Required	Contains the version information about the alarm block.
SubmoduleDataBlockVersion	Unsigned 16	Required	Contains the version information about the submodule data block.

D.4.5.11 ApplicationRelations/TimingProperties

This element defines the timing behaviour for sending cyclic IO data.

Use: Optional

Each element shall contain attributes as shown in Table D.23.

Table D.23 — Attributes of element TimingProperties

Name	Type	Use	Description
SendClock	ValueList	Optional	Contains a list of cycle times supported by the DAP for sending cyclic data. Basic clock tick is 31,25 microseconds. Each value of this element contains the multiplier of the basic clock tick and can be in the range "1" to "128" (see Example). Default is “32”.
ReductionRatio	ValueList	Optional	The send clock interval can be reduced by a reduction. This attribute describes the supported reduction ratios of a DAP. Each value of this element shall be in the range "1" to " 16384".
EXAMPLE SendClock="16, 32, 64" means that the DAP is able to send cyclic data in interval 500µs, 1ms or 2ms.			

D.4.6 Submodule related elements

D.4.6.1 VirtualSubmoduleItem

This element defines the characteristics of a submodule as part of a module.

Use: Required

Each element shall contain attributes as shown in Table D.24.

Table D.24 — Attributes of element VirtualSubmoduleItem

Name	Type	Use	Description
ID	IdT	Required	Contains the ID of the element
SubmoduleIdentNumber	NormalizedString	Required	Contains the Submodule Ident Number for identification purposes. In this release of the GSDML the value has to be set to "0x00000000"

D.4.6.2 VirtualSubmoduleItem/IOData

This element defines characteristics of the IO data of a submodule.

Use: Required

Each element shall contain attributes as shown in Table D.25.

Table D.25 — Attributes of element IOData

Name	Type	Use	Description
IOPS_Length	Unsigned8	Optional	Contains the Length of the IO producer status in octets as part of an IO data object. Default: 1 octet
IOCS_Length	Unsigned8	Optional	Contains the Length of the IO consumer status in octets as part of an IO data object. Default: 1 octet

D.4.6.3 VirtualSubmoduleItem/IOData/Input

Specifies the input characteristics of a submodule. If input data is available, this element has DataItem elements (see D.4.6.4).

Use: Optional.

Each element shall contain the attribute as shown in Table D.26.

Table D.26 — Attribute of element Input

Name	Type	Use	Description
Consistency	Enumeration	Optional	If this attribute is set to Item consistency, the consistency is only given within a DataItem. If this attribute is set to "All items consistency", then the submodule provides consistency for all data items. Default is “Item consistency”.

D.4.6.4 VirtualSubmoduleItem/IOData/Input/DataItem

The DataItem element contains information about a single DataItem.

Use: One for every DataItem.

Each element shall contain attributes as shown in Table D.27.

Table D.27 — Attributes of element DataItem

Name	Type	Use	Description
DataType	Enumeration	Required	Defines the data type of the data item. One of the following values is allowed: “Integer8” “Integer16” “Integer32” “Integer64” “Unsigned8” “Unsigned16” “Unsigned32” “Unsigned64” “Float32” “Float64” “Date” “TimeOfDay with date indication” “TimeOfDay without date indication” “TimeDifference with date indication” “TimeDifference without date indication” “NetworkTime” “NetworkTimeDifference” “VisibleString” “OctetString”
Length	Unsigned16	Optional	This attribute shall be used if the attribute DataType is set to "VisibleString" or "OctetString". This attribute specifies the length of the element DataItem in octets.[a] If this attribute is used for datatypes with fixed length definition, the length shall correspond to the definition in IEC 61158-5.
UseAsBits	Boolean	Optional	If the attribute is set to “true”, the engineering system should display the data item in a bit representation. Default is "false".
TextId	Token	Required	Contains the ID of a text as a reference into the "ExternalTextList" (see D.4.4.24).
[a] This is necessary because these datatypes have a variable length.			

D.4.6.5 VirtualSubmoduleItem/IOData/Output

The Output element specifies the output characteristics of a submodule. If output data is available, this element contains DataItem elements (see D.4.6.6).

Use: Optional

Attributes: see D.4.6.3.

D.4.6.6 VirtualSubmoduleItem/IOData/Output/DataItem

The DataItem element contains information about a single DataItem.

Use: One for every DataItem.

Attributes: see D.4.6.4.

D.4.6.7 VirtualSubmoduleItem/RecordDataList

This element contains a list of ParameterRecordDataItem (see D.4.7.1).

Attributes: None

D.4.6.8 VirtualSubmoduleItem/ModuleInfo

See D.4.8.1.

D.4.6.9 VirtualSubmoduleItem/Graphics

See D.4.8.9.

D.4.7 RecordDataList related elements

D.4.7.1 ParameterRecordDataItem

A ParameterRecordDataItem element describes the data structure of a parameter record data object.

NOTE All parameters of a ParameterRecordDataItems will be transferred to the submodule during the start-up procedure of an IO device.

Use: One or more

Each element shall contain attributes as shown in Table D.28.

Table D.28 — Attributes of element ParameterRecordDataItem

Name	Type	Use	Description
Index	Unsigned16	Required	Contains the unique ID of a record data object that is used to address the object with PROFINET IO Remote Procedure Calls (RPC).
Length	Unsigned32	Required	Contains the length of the record data object in octets.
TransferSequence	Unsigned16	Optional	This attribute controls the transfer sequence of the ParameterRecordData objects during start-up. The TransferSequence attribute shall be unique within a submodule. The first transferred ParameterRecordData object shall have this attribute set to “1”, the following objects shall have this attribute incremented in direct sequence (without gaps). If this attribute is set to "0" (which is the default) then the transfer sequence is undefined.
EXAMPLE 1 A valid configuration: TransferSequence First Object: 1 Second Object: 2 Third Object: 3 EXAMPLE 2 Invalid configurations: 2,3,4: Does not start with “1” 1,2,4: Number “3” is missing 1,2,2: Multiple Use of number “2”			

D.4.7.2 RecordDataItem/Name

The Name element gives the record data object a human readable name.

NOTE This allows an engineering tool to group the data objects of a record data object so that, for example a dialog can use this name as dialog title.

Use: Required

Each element shall contain attributes as shown in Table D.29.

Table D.29 — Attributes of element Name

Name	Type	Use	Description
TextId	Token	Required	Contains the ID of a text as a reference into the ExternalTextList (see D.4.4.24).

D.4.7.3 RecordDataItem/Const

The Const element is used to initialize the content of a record data object. If the Const definition does not describe the complete content of the record data object, the undefined fields shall be set to zero.

If the Const element is missing, the record data object is initialized with octets set to zero.

If more than one Const element is defined no overlapping between the definitions is allowed.

Use: Zero or more

Each element shall contain attributes as shown in Table D.30.

Table D.30 — Attributes of element Const

Name	Type	Use	Description
ByteOffset	Unsigned32	Optional	Contains the offset in octets of the referenced data object from the beginning of the record data object. Default: "0" The length of the const definition shall be less or equal to the Length attribute of the RecordDataItem element.
Data	NormalizedString	Required	Contains the data content of the record data object starting at “ByteOffset” (see Example). The string is separated in hexadecimal tokens and shall fulfil the rules of the following regular expression: (0x[0-9,a-f,A-F][0-9,a-f,A-F],?){1,}
EXAMPLE 0x10,0xff, 0x4A			

D.4.7.4 VirtualSubmoduleItem/RecordDataList/RecordDataItem/Ref

This element references a data object in a record data block.

Because this element may describe the same object as the element “const”, overlapping may occur. In this case, the “Ref” definition shall be used.

Use: Zero or more

Each element shall contain attributes as shown in Table D.31.

Table D.31 — Attributes of element Ref

Name	Type	Use	Description
ValueItemTarget	RefIdT	Optional	References a ValueDataItem Element containing the name and value range of the data object.
ByteOffset	Unsigned32	Required	Contains the offset in octets of the referenced data object from the beginning of the record data object.
BitOffset	NormalizedString	Optional	Contains the offset in bits of the referenced data object from the beginning of the referenced octet. Valid Range: 0..7 Default: 0 Can only be used in conjunction with data type “Bit” or “BitArea”.
BitLength	Unsigned 8	Optional	If the type of this data object is “BitArea”, this attribute specifies the length of this field. The attribute is ignored if another data type is used. Defaut is "1" The BitLength shall be in range from "1" to "15".
DataType	Enumeration	Required	Specifies the type of the data object. One of the following values are to use: “Bit” “BitArea” (see Note) “Integer8” “Integer16” “Integer32” “Signed64” “Unsigned8” “Unsigned16” “Unsigned32” “Unsigned64”
DefaultValue	NormalizedString	Required	Contains the default value for the parameter. The value shall comply with the following regular expression: \-?[\d+]{1,20}
AllowedValues	SignedValueList	Optional	Specifies the possible values for this parameter. If this attribute is not used the following rules shall be applied: If the attribute ValueItemTarget is used the value range of the parameter is defined by the attribute Content of the elements Assignments of the referenced ValueItem. If the attribute ValueItemTarget is not used or the referenced ValueItem does not contain Assignments elements, the value range of the parameter is defined by the data type defined by the attribute DataType. If the attributes AllowedValues and ValueItemTarget are both used, the attribute AllowedValues shall only contain values defined as attribute Content of the Assignments elements of the referenced ValueItem. If the ValueItem does not contain Assignments elements, every value within the value range of the data type for AllowedValues is valid.
Changeable	Boolean	Optional	If this Attribute is set to “false”, no changes of this parameter are allowed. Default = “true”

Name	Type	Use	Description
Visible	Boolean	Optional	If this Attribute is set to “false”, this parameter will not be displayed in the engineering tool. The “false” setting does not make sense in combination with “Changeable=”true”. The Schema is not able to assert this mutual exclusion. Default = “true”
TextId	Token	Required	Contains the ID of a text as a reference into the ExternalTextList (see D.4.4.24).
NOTE The "BitArea" data type can be used to reduce the size of a record data object because it has a variable bit length. For example if a parameter can only have four different values, a BitArea with the length of 2 bit is sufficient. A "BitArea" parameter can contain codings or separate bits.			

The following example shows the usage of the various lists to describe a module with one parameter data record object and two parameters:

EXAMPLE

```
<RecordDataList>
<!--The module has one 20 octet record data object with index “1”. The description of this record data object is “General Parameter” in the english language.-->
  <ParameterDataRecordItem Index="1" Length="20">
    <Name TextId="General Parameter"/>
    <Ref ValueItemTarget="AlarmEnabling"     DataType="Bit" ByteOffset="8" BitOffset="0"
                                        DefaultValue="0" AllowedValues="0..1" TextId="ID_TEXT1"/>
    <Ref ValueItemTarget="IF Supp" DataType="BitArea" ByteOffset="10" BitOffset="0" BitLength="2"
                                        DefaultValue="0" AllowedValues="0..2"  TextId="ID_TEXT2"/>
  </ParameterDataRecordItem>
</RecordDataList>

<ValueList>
  <ValueItem ID="AlarmEnabling">
       <NameTextId="ID_ENABLE_ALARMS"/>
                    <Assignments>
                       <Assign Content="0" TextId="No"/>
                       <Assign Content="1" TextId="yes"/>
                     </Assignments>
  </ValueItem>
  <ValueItem ID=" IF Supp">
       <NameTextId="ID_IF_SUPP"/>
                    <Assignments>
                       <Assign Content="0" TextId="50 Hz"/>
                       <Assign Content="1" TextId="60 Hz"/>
                       <Assign Content="2" TextId="400 Hz"/>
                    </Assignments>
    </ValueItem>
</ValueList>
```

D.4.8 Globally used elements

D.4.8.1 ModuleInfo

This element contains general Information about a module or submodule.

Each element shall contain attributes as shown in Table D.32.

Table D.32 — Attributes of element ModuleInfo

Name	Type	Use	Description
CategoryRef	RefIdT	Optional	Contains the catogory of an module. The value of CategoryRef shall contain an ID of an element CategoryList/CategoryItem (see D.4.4.23).
SubCategory1Ref	RefIdT	Optional	Within a category, subcategories can be created. The value of CategoryRef shall contain an element CategoryList/CategoryItem (see D.4.4.23).

D.4.8.2 ModuleInfo/Name

The Name element contains the language dependent name of a module or submodule.

Use: Required.

Each element shall contain attributes as shown in Table D.33.

Table D.33 — Attributes of element Name

Name	Type	Use	Description
TextId	Token	Required	Contains the ID of a text as a reference into the ExternalTextList (see D.4.4.24).

D.4.8.3 ModuleInfo/InfoText

The InfoText element contains human readable text information about a module or submodule.

Use: Required.

Each element shall contain attributes as shown in Table D.34.

Table D.34 — Attributes of element InfoText

Name	Type	Use	Description
TextId	Token	Required	Contains the ID of a text as a reference into the ExternalTextList (see D.4.4.24).

D.4.8.4 ModuleInfo/VendorName

The VendorName element contains the name of the device vendor. If this element does not exist, the vendor name of the element “DeviceInfo/Vendorname” shall be used.

Use: Optional

Each element shall contain attributes as shown in Table D.35.

Table D.35 — Attributes of element VendorName

Name	Type	Use	Description
Value	Token	Required	Contains the name of the device vendor.

D.4.8.5 ModuleInfo/OrderNumber

The OrderNumber element contains the order number of a module or submodule.

Use: Optional

Each element shall contain attributes as shown in Table D.36.

Table D.36 — Attributes of element OrderNumber

Name	Type	Use	Description
Value	Token	Required	Contains the order number of a module or submodule.

D.4.8.6 ModuleInfo/HardwareRelease

The HardwareRelease element contains the hardware release of a module or submodule.

Use: Optional

Each element shall contain attributes as shown in Table D.37.

Table D.37 — Attributes of element HardwareRelease

Name	Type	Use	Description
Value	Token	Required	Contains the hardware release of a module or submodule.

D.4.8.7 ModuleInfo/SoftwareRelease

Contains the software release of a module/submodule.

Use: Optional

Each element shall contain attributes as shown in Table D.38.

Table D.38 — Attributes of element SoftwareRelease

Name	Type	Use	Description
Value	Token	Required	Contains the software release of a module or submodule.

D.4.8.8 ModuleInfo/Family

See D.4.3.2.

D.4.8.9 Graphics

The Graphics element contains a list of GraphicItemRef (see D.4.8.10).

Use: Optional

Attributes: None

D.4.8.10 Graphics/GraphicItemRef

The GraphicItemRef element references graphical information about a device module or submodule.

Use: One or more

Each element shall contain attributes as shown in Table D.39.

Table D.39 — Attributes of element GraphicItemRef

Name	Type	Use	Description
Type	Enumeration	Required	Describes the type of the Graphic Item. One of the following values can be used: "DeviceSymbol" "DeviceIcon" Within one "Graphics" element only one GraphicItemRef of one type shall be used. If a "DeviceSymbol" type is used, the assigned GraphicItem shall be a bitmap file in the DIB Format (70*40 pixels (width*height) 16 colors). For a DeviceAccessPointItem the GraphicItem should represent the device. For modules and submodules the GraphicItem should represent the module or submodule. If a "DeviceIcon" type is used, the assigned GraphicItem shall be a file in icon format.
GraphicItemTarget	RefIdT	Required	Reference to an element GraphicsList/GraphicItem (see D.4.4.20).

D.5 GSDML device profile template schemas

D.5.1 General

NOTE The following schema definitions make use of xml.xsd. This schema file is provided by the World Wide Web Consortium. W3C offers to download this file using the namespace identifier as an internet URL.

D.5.2 GSDML device profile schema (GSDML-DeviceProfile-v1.0.xsd)

```
<?xml version="1.0" encoding="UTF-8"?>
<xsd:schema targetNamespace="http://www.profibus.com/GSDML/2003/11/DeviceProfile"
xmlns="http://www.profibus.com/GSDML/2003/11/DeviceProfile"
xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:base="http://www.profibus.com/GSDML/2003/11/Primitives" elementFormDefault="qualified"
attributeFormDefault="unqualified" version="1.0">
   <xsd:import namespace="http://www.w3.org/XML/1998/namespace" schemaLocation="xml.xsd"/>
   <xsd:import namespace="http://www.profibus.com/GSDML/2003/11/Primitives" schemaLocation="GSDML-
Primitives-v1.0.xsd"/>
   <!--_____________________________________________________-->
   <!-- *** ISO 15745 Profile definition ***-->
   <xsd:element name="ISO15745Profile">
      <xsd:complexType>
         <xsd:sequence>
            <xsd:element ref="ProfileHeader"/>
            <xsd:element ref="ProfileBody"/>
         </xsd:sequence>
      </xsd:complexType>
      <xsd:key name="ExternalText_ID">
         <xsd:selector xpath=".//*/PrimaryLanguage/Text"/>
         <xsd:field xpath="@TextId"/>
      </xsd:key>
      <xsd:key name="DeviceAccessPointItem_ID">
         <xsd:selector xpath=".//*/DeviceAccessPointList/DeviceAccessPointItem"/>
         <xsd:field xpath="@ID"/>
```

```
      </xsd:key>
      <xsd:key name="ModuleItem_ID">
         <xsd:selector xpath=".//*/ModuleList/ModuleItem"/>
         <xsd:field xpath="@ID"/>
      </xsd:key>
      <xsd:key name="SubModuleItem_ID">
         <xsd:selector xpath=".//*/VirtualSubmoduleList/VirtualSubmoduleItem"/>
         <xsd:field xpath="@ID"/>
      </xsd:key>
      <xsd:key name="ValueItem_ID">
         <xsd:selector xpath=".//*/ValueList/ValueItem"/>
         <xsd:field xpath="@ID"/>
      </xsd:key>
      <xsd:key name="GraphicItem_ID">
         <xsd:selector xpath=".//*/GraphicsList/GraphicItem"/>
         <xsd:field xpath="@ID"/>
      </xsd:key>
      <xsd:key name="CategoryItem_ID">
         <xsd:selector xpath=".//*/CategoryList/CategoryItem"/>
         <xsd:field xpath="@ID"/>
      </xsd:key>
      <xsd:keyref name="UseableModuleItemRef" refer="ModuleItem_ID">
         <xsd:selector xpath=".//*/ModuleItemRef"/>
         <xsd:field xpath="@ModuleItemTarget"/>
      </xsd:keyref>
      <xsd:keyref name="GraphicsRef" refer="GraphicItem_ID">
         <xsd:selector xpath=".//*/GraphicItemRef"/>
         <xsd:field xpath="@GraphicItemTarget"/>
      </xsd:keyref>
      <xsd:keyref name="CategoryRef" refer="CategoryItem_ID">
         <xsd:selector xpath=".//*/ModuleInfo"/>
         <xsd:field xpath="@CategoryRef"/>
      </xsd:keyref>
      <xsd:keyref name="ValueItemRef" refer="ValueItem_ID">
         <xsd:selector xpath=".//*/Ref"/>
         <xsd:field xpath="@ValueItemTarget"/>
      </xsd:keyref>
      <xsd:keyref name="TextRef" refer="ExternalText_ID">
         <xsd:selector xpath=".//DeviceIdentity/*"/>
         <xsd:field xpath="@TextId"/>
      </xsd:keyref>
      <xsd:keyref name="TextRef1" refer="ExternalText_ID">
         <xsd:selector xpath=".//DeviceFunction/*"/>
         <xsd:field xpath="@TextId"/>
      </xsd:keyref>
      <xsd:keyref name="TextRef2" refer="ExternalText_ID">
         <xsd:selector
xpath=".//DeviceAccessPointList/*|.//ModuleList/*|.//ValueList/*|.//ChannelDiagList/*|.//UnitDiagType
List/*|.//GraphicsList/*|.//CategoryList/*"/>
         <xsd:field xpath="@TextId"/>
      </xsd:keyref>
   </xsd:element>
   <!--_____________________________________________________________-->
   <!-- *** ProfileHeader ***-->
   <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"/>
            <xsd:element name="ISO15745Reference" type="ISO15745Reference_DataType"/>
            <xsd:element name="IASInterfaceType" type="IASInterface_DataType" minOccurs="0"
maxOccurs="unbounded"/>
         </xsd:sequence>
      </xsd:complexType>
   </xsd:element>
   <!--_____________________________________________________________-->
   <!-- *** ProfileBody ***-->
   <xsd:element name="ProfileBody">
      <xsd:complexType>
         <xsd:sequence>
            <xsd:element ref="DeviceIdentity" minOccurs="0"/>
```

```
         <xsd:element ref="DeviceManager" minOccurs="0"/>
         <xsd:element ref="DeviceFunction" maxOccurs="unbounded"/>
         <xsd:element ref="ApplicationProcess" minOccurs="0" maxOccurs="unbounded"/>
         <xsd:element name="ExternalProfileHandle" type="ProfileHandle_DataType" minOccurs="0"/>
      </xsd:sequence>
   </xsd:complexType>
</xsd:element>
<!--_____________________________________________________________-->
<!-- *** DeviceIdentity related ***-->
<xsd:element name="DeviceIdentity">
   <xsd:complexType>
      <xsd:sequence>
         <xsd:element name="InfoText" type="base:LocalizableTextParameterT"/>
         <xsd:element name="VendorName" type="base:TokenParameterT"/>
      </xsd:sequence>
      <xsd:attribute name="VendorID" use="required">
         <xsd:simpleType>
            <xsd:restriction base="xsd:normalizedString">
               <xsd:pattern value="0x[0-9,a-f,A-F]{1,4}"/>
            </xsd:restriction>
         </xsd:simpleType>
      </xsd:attribute>
      <xsd:attribute name="DeviceID" use="required">
         <xsd:simpleType>
            <xsd:restriction base="xsd:normalizedString">
               <xsd:pattern value="0x[0-9,a-f,A-F]{1,4}"/>
            </xsd:restriction>
         </xsd:simpleType>
      </xsd:attribute>
   </xsd:complexType>
</xsd:element>
<!--_____________________________________________________________-->
<!-- *** DeviceManager related ***-->
<xsd:element name="DeviceManager"/>
<!--_____________________________________________________________-->
<!-- *** DeviceFunction related ***-->
<xsd:element name="DeviceFunction">
   <xsd:complexType>
      <xsd:sequence>
         <xsd:element name="Family" type="base:FamilyT"/>
      </xsd:sequence>
   </xsd:complexType>
</xsd:element>
<!--_____________________________________________________________-->
<!-- *** ApplicationProcess related ***-->
<xsd:element name="ApplicationProcess">
   <xsd:complexType>
      <xsd:sequence>
         <xsd:element ref="DeviceAccessPointList"/>
         <xsd:element ref="ModuleList"/>
         <xsd:element ref="ValueList" minOccurs="0"/>
         <xsd:element ref="ChannelDiagList" minOccurs="0"/>
         <xsd:element ref="UnitDiagTypeList" minOccurs="0"/>
         <xsd:element ref="GraphicsList" minOccurs="0"/>
         <xsd:element ref="CategoryList" minOccurs="0"/>
         <xsd:element ref="ExternalTextList"/>
      </xsd:sequence>
   </xsd:complexType>
</xsd:element>
<xsd:element name="DeviceAccessPointList">
   <xsd:complexType>
      <xsd:annotation>
         <xsd:documentation>Defines an AccessPoint list of a device.</xsd:documentation>
      </xsd:annotation>
      <xsd:sequence>
         <xsd:element ref="DeviceAccessPointItem" maxOccurs="unbounded"/>
      </xsd:sequence>
   </xsd:complexType>
</xsd:element>
<xsd:element name="ModuleList">
   <xsd:complexType>
      <xsd:annotation>
         <xsd:documentation>Defines a module list of a device.</xsd:documentation>
      </xsd:annotation>
      <xsd:sequence>
         <xsd:element ref="ModuleItem" maxOccurs="unbounded"/>
```

```
         </xsd:sequence>
      </xsd:complexType>
   </xsd:element>
   <xsd:element name="ValueList">
      <xsd:complexType>
         <xsd:sequence>
            <xsd:element name="ValueItem" maxOccurs="unbounded">
               <xsd:complexType>
                  <xsd:complexContent>
                     <xsd:extension base="base:ObjectT">
                        <xsd:sequence>
                           <xsd:element name="Help" type="base:LocalizableTextParameterT"
minOccurs="0"/>
                           <xsd:element name="Assignments" minOccurs="0">
                              <xsd:complexType>
                                 <xsd:sequence>
                                    <xsd:element name="Assign" maxOccurs="unbounded">
                                       <xsd:complexType>
                                          <xsd:complexContent>
                                             <xsd:extension base="base:LocalizableTextParameterT">
                                                <xsd:attribute name="Content" use="required">
                                                   <xsd:simpleType>
                                                      <xsd:restriction base="xsd:normalizedString">
                                                         <xsd:pattern value="\-?[\d+]{1,20}"/>
                                                      </xsd:restriction>
                                                   </xsd:simpleType>
                                                </xsd:attribute>
                                             </xsd:extension>
                                          </xsd:complexContent>
                                       </xsd:complexType>
                                    </xsd:element>
                                 </xsd:sequence>
                              </xsd:complexType>
                           </xsd:element>
                        </xsd:sequence>
                     </xsd:extension>
                  </xsd:complexContent>
               </xsd:complexType>
            </xsd:element>
         </xsd:sequence>
      </xsd:complexType>
   </xsd:element>
   <xsd:element name="ChannelDiagList">
      <xsd:complexType>
         <xsd:annotation>
            <xsd:documentation>Specifies a list of channel type specific error text with help
information.</xsd:documentation>
         </xsd:annotation>
         <xsd:sequence>
            <xsd:element name="ChannelDiagItem" maxOccurs="unbounded">
               <xsd:complexType mixed="true">
                  <xsd:annotation>
                     <xsd:documentation>Defines a channel type specific error text with help
information.</xsd:documentation>
                  </xsd:annotation>
                  <xsd:sequence>
                     <xsd:element name="Name" type="base:LocalizableTextParameterT"/>
                     <xsd:element name="Help" type="base:LocalizableTextParameterT" minOccurs="0"/>
                  </xsd:sequence>
                  <xsd:attribute name="ErrorType" type="base:unsigned16T" use="required"/>
               </xsd:complexType>
            </xsd:element>
         </xsd:sequence>
      </xsd:complexType>
   </xsd:element>
   <xsd:element name="UnitDiagTypeList">
      <xsd:complexType>
         <xsd:sequence>
            <xsd:element name="UnitDiagTypeItem" maxOccurs="unbounded">
               <xsd:complexType>
                  <xsd:sequence>
                     <xsd:element name="Ref" type="ValueItemReferenceT" maxOccurs="unbounded"/>
                  </xsd:sequence>
                  <xsd:attribute name="UserStructureIdentifier" type="base:unsigned16T"
use="required"/>
               </xsd:complexType>
```

```
            </xsd:element>
         </xsd:sequence>
      </xsd:complexType>
   </xsd:element>
   <xsd:element name="GraphicsList">
      <xsd:complexType>
         <xsd:annotation>
            <xsd:documentation>Contains a list of graphic items, which can contain either external
references to graphic files or embedded graphic information.</xsd:documentation>
         </xsd:annotation>
         <xsd:sequence>
            <xsd:element name="GraphicItem" maxOccurs="unbounded">
               <xsd:complexType mixed="true">
                  <xsd:annotation>
                     <xsd:documentation>Contains information about a graphic.  An external reference
to a graphics file and optionally embedded graphics information can be given.</xsd:documentation>
                  </xsd:annotation>
                  <xsd:sequence minOccurs="0">
                     <xsd:element name="Embedded">
                        <xsd:annotation>
                           <xsd:documentation>Contains embedded graphics information in SVG
format.</xsd:documentation>
                        </xsd:annotation>
                        <xsd:complexType mixed="true">
                           <xsd:annotation>
                              <xsd:documentation>This parameter enables embedding graphic
information into the XML document.</xsd:documentation>
                           </xsd:annotation>
                           <xsd:complexContent mixed="true">
                              <xsd:restriction base="xsd:anyType">
                                 <xsd:sequence>
                                    <xsd:any namespace="##any" processContents="lax" minOccurs="0"
maxOccurs="unbounded">
                                       <xsd:annotation>
                                          <xsd:documentation>This element contains graphics
information in SVG (Scalable Vector Graphics) format.</xsd:documentation>
                                       </xsd:annotation>
                                    </xsd:any>
                                 </xsd:sequence>
                              </xsd:restriction>
                           </xsd:complexContent>
                        </xsd:complexType>
                     </xsd:element>
                  </xsd:sequence>
                  <xsd:attribute name="ID" type="base:IdT" use="required"/>
                  <xsd:attribute name="GraphicFile" type="xsd:string" use="required"/>
               </xsd:complexType>
            </xsd:element>
         </xsd:sequence>
      </xsd:complexType>
   </xsd:element>
   <xsd:element name="CategoryList">
      <xsd:complexType>
         <xsd:annotation>
            <xsd:documentation>Defines a list of text definitions for catalog categories for modules
and submodules.</xsd:documentation>
         </xsd:annotation>
         <xsd:sequence>
            <xsd:element name="CategoryItem" maxOccurs="unbounded">
               <xsd:complexType>
                  <xsd:complexContent>
                     <xsd:extension base="base:ObjectT">
                        <xsd:attribute name="TextId" type="xsd:token" use="required"/>
                     </xsd:extension>
                  </xsd:complexContent>
               </xsd:complexType>
            </xsd:element>
         </xsd:sequence>
      </xsd:complexType>
   </xsd:element>
   <xsd:element name="ExternalTextList">
      <xsd:complexType>
         <xsd:sequence>
            <xsd:element name="PrimaryLanguage">
               <xsd:complexType>
                  <xsd:sequence>
```

```
                        <xsd:element name="Text" type="ExternalTextT" maxOccurs="unbounded"/>
                     </xsd:sequence>
                  </xsd:complexType>
               </xsd:element>
               <xsd:element name="Language" minOccurs="0" maxOccurs="unbounded">
                  <xsd:complexType>
                     <xsd:sequence>
                        <xsd:element name="Text" type="ExternalTextT" maxOccurs="unbounded"/>
                     </xsd:sequence>
                     <xsd:attribute ref="xml:lang"/>
                  </xsd:complexType>
               </xsd:element>
            </xsd:sequence>
         </xsd:complexType>
      </xsd:element>
      <!--_____________________________________________________________-->
      <!--  *** Globally defined elements ***-->
      <xsd:element name="DeviceAccessPointItem">
         <xsd:complexType>
            <xsd:annotation>
               <xsd:documentation>Represents the Device Access Point  for PROFINET IO
Devices.</xsd:documentation>
            </xsd:annotation>
            <xsd:complexContent>
               <xsd:extension base="base:ObjectT">
                  <xsd:sequence>
                     <xsd:element name="ModuleInfo" type="ModuleInfoT"/>
                     <xsd:element name="IOConfigData">
                        <xsd:complexType>
                           <xsd:annotation>
                              <xsd:documentation>Contains general device specific IO data
definitions.</xsd:documentation>
                           </xsd:annotation>
                           <xsd:attribute name="MaxInputLength" type="base:unsigned16T"
use="required"/>
                           <xsd:attribute name="MaxOutputLength" type="base:unsigned16T"
use="required"/>
                           <xsd:attribute name="MaxDataLength" type="base:unsigned16T" use="optional"/>
                        </xsd:complexType>
                     </xsd:element>
                     <xsd:element name="UseableModules">
                        <xsd:complexType>
                           <xsd:annotation>
                              <xsd:documentation>Contains a list of module references which can be used
with this access point.</xsd:documentation>
                           </xsd:annotation>
                           <xsd:sequence>
                              <xsd:element name="ModuleItemRef" maxOccurs="unbounded">
                                 <xsd:complexType>
                                    <xsd:attribute name="ModuleItemTarget" type="xsd:string"
use="required"/>
                                    <xsd:attribute name="AllowedInSlots" type="base:ValueListT"
use="optional"/>
                                    <xsd:attribute name="UsedInSlots" type="base:ValueListT"
use="optional"/>
                                    <xsd:attribute name="FixedInSlots" type="base:ValueListT"
use="optional"/>
                                 </xsd:complexType>
                              </xsd:element>
                           </xsd:sequence>
                        </xsd:complexType>
                     </xsd:element>
                     <xsd:element name="VirtualSubmoduleList" type="VirtualSubmoduleListT"/>
                     <xsd:element name="Graphics" type="GraphicsReferenceT" minOccurs="0"/>
                     <xsd:element ref="ApplicationRelations" minOccurs="0"/>
                  </xsd:sequence>
                  <xsd:attribute name="PhysicalSlots" type="base:ValueListT" use="required"/>
                  <xsd:attribute name="ModuleIdentNumber" use="required">
                     <xsd:simpleType>
                        <xsd:restriction base="xsd:normalizedString">
                           <xsd:pattern value="0x[0-9,a-f,A-F]{1,8}"/>
                        </xsd:restriction>
                     </xsd:simpleType>
                  </xsd:attribute>
                  <xsd:attribute name="MinDeviceInterval" type="base:unsigned16T" use="required"/>
                  <xsd:attribute name="ImplementationType" type="xsd:normalizedString" use="optional"/>
```

```
               <xsd:attribute name="DNS_CompatibleName" use="required">
                  <xsd:simpleType>
                     <xsd:restriction base="xsd:normalizedString">
                        <xsd:pattern value="([0-9,a-z,A-Z]|[0-9,a-z,A-Z]-)*[0-9,a-z,A-Z]"/>
                     </xsd:restriction>
                  </xsd:simpleType>
               </xsd:attribute>
               <xsd:attribute name="ExtendedAddressAssignmentSupported" type="xsd:boolean"
use="optional" default="false"/>
               <xsd:attribute name="AllowedInSlots" type="base:ValueListT" use="optional">
                  <xsd:annotation>
                     <xsd:documentation>If the Device AccessPoint can be placed into more than one
slot, this parameter specifies the possible slots.</xsd:documentation>
                  </xsd:annotation>
               </xsd:attribute>
               <xsd:attribute name="FixedInSlots" type="base:ValueListT" use="required"/>
               <xsd:attribute name="ObjectUUID_LocalIndex" type="base:unsigned16T" use="required"/>
            </xsd:extension>
         </xsd:complexContent>
      </xsd:complexType>
   </xsd:element>
   <xsd:element name="ApplicationRelations">
      <xsd:complexType>
         <xsd:sequence>
            <xsd:element name="TimingProperties" minOccurs="0">
               <xsd:complexType>
                  <xsd:attribute name="SendClock" type="base:ValueListT" use="optional"
default="32">
                     <xsd:annotation>
                        <xsd:documentation>Defines the minimal clock for sending cyclic data. Basic
clock is 31,25 mircoseconds. The value of this element contains the factor of the basic
clock.</xsd:documentation>
                     </xsd:annotation>
                  </xsd:attribute>
                  <xsd:attribute name="ReductionRatio" type="base:ValueListT" use="optional">
                     <xsd:annotation>
                        <xsd:documentation>Contains a list of Values, describing the supported
reduction ratios of an access point </xsd:documentation>
                     </xsd:annotation>
                  </xsd:attribute>
               </xsd:complexType>
            </xsd:element>
         </xsd:sequence>
         <xsd:attribute name="AR_BlockVersion" type="base:unsigned16T" use="required"/>
         <xsd:attribute name="IOCR_BlockVersion" type="base:unsigned16T" use="required"/>
         <xsd:attribute name="AlarmCR_BlockVersion" type="base:unsigned16T" use="required"/>
         <xsd:attribute name="SubmoduleDataBlockVersion" type="base:unsigned16T" use="required"/>
      </xsd:complexType>
   </xsd:element>
   <xsd:element name="ModuleItem">
      <xsd:annotation>
         <xsd:documentation>Defines the contents of a module in GSDML Device
Description.</xsd:documentation>
      </xsd:annotation>
      <xsd:complexType>
         <xsd:complexContent>
            <xsd:extension base="base:ObjectT">
               <xsd:sequence>
                  <xsd:element name="ModuleInfo">
                     <xsd:complexType>
                        <xsd:complexContent>
                           <xsd:extension base="ModuleInfoT"/>
                        </xsd:complexContent>
                     </xsd:complexType>
                  </xsd:element>
                  <xsd:element name="VirtualSubmoduleList" type="VirtualSubmoduleListT">
                     <xsd:annotation>
                        <xsd:documentation>Only contains virtual submodules.</xsd:documentation>
                     </xsd:annotation>
                  </xsd:element>
                  <xsd:element name="Graphics" type="GraphicsReferenceT" minOccurs="0"/>
               </xsd:sequence>
               <xsd:attribute name="ModuleIdentNumber" use="required">
                  <xsd:simpleType>
                     <xsd:restriction base="xsd:normalizedString">
                        <xsd:pattern value="0x[0-9,a-f,A-F]{1,8}"/>
```

```
                    </xsd:restriction>
                 </xsd:simpleType>
              </xsd:attribute>
           </xsd:extension>
        </xsd:complexContent>
     </xsd:complexType>
  </xsd:element>
  <xsd:element name="VirtualSubmoduleItem">
     <xsd:annotation>
        <xsd:documentation>Defines the contents of a submodule in GSDML Device
Description.</xsd:documentation>
     </xsd:annotation>
     <xsd:complexType>
        <xsd:complexContent>
           <xsd:extension base="base:ObjectT">
              <xsd:sequence>
                 <xsd:element name="IOData">
                    <xsd:complexType>
                       <xsd:annotation>
                          <xsd:documentation>Defines the input and output data items for a
submodule.</xsd:documentation>
                       </xsd:annotation>
                       <xsd:sequence>
                          <xsd:element name="Input" minOccurs="0">
                             <xsd:complexType mixed="true">
                                <xsd:annotation>
                                   <xsd:documentation>Contains the DataItems used to describe the
input  data.</xsd:documentation>
                                </xsd:annotation>
                                <xsd:sequence>
                                   <xsd:element name="DataItem" maxOccurs="unbounded">
                                      <xsd:complexType mixed="true">
                                         <xsd:complexContent mixed="true">
                                            <xsd:extension base="DataItemT"/>
                                         </xsd:complexContent>
                                      </xsd:complexType>
                                   </xsd:element>
                                </xsd:sequence>
                                <xsd:attribute name="Consistency"
type="base:IODataConsistencyEnumT" use="optional" default="Item consistency"/>
                             </xsd:complexType>
                          </xsd:element>
                          <xsd:element name="Output" minOccurs="0">
                             <xsd:complexType mixed="true">
                                <xsd:annotation>
                                   <xsd:documentation>Contains the DataItems used to describe the
output  data.</xsd:documentation>
                                </xsd:annotation>
                                <xsd:sequence>
                                   <xsd:element name="DataItem" maxOccurs="unbounded">
                                      <xsd:complexType mixed="true">
                                         <xsd:complexContent mixed="true">
                                            <xsd:extension base="DataItemT"/>
                                         </xsd:complexContent>
                                      </xsd:complexType>
                                   </xsd:element>
                                </xsd:sequence>
                                <xsd:attribute name="Consistency"
type="base:IODataConsistencyEnumT" use="optional" default="Item consistency"/>
                             </xsd:complexType>
                          </xsd:element>
                       </xsd:sequence>
                       <xsd:attribute name="IOPS_Length" type="base:unsigned16T" use="optional"
default="1">
                          <xsd:annotation>
                             <xsd:documentation>Length of the IO producer status within an io data
object.</xsd:documentation>
                          </xsd:annotation>
                       </xsd:attribute>
                       <xsd:attribute name="IOCS_Length" type="base:unsigned16T" use="optional"
default="1">
                          <xsd:annotation>
                             <xsd:documentation>Length of the IO consumer status within an io data
object.</xsd:documentation>
                          </xsd:annotation>
                       </xsd:attribute>
```

```
                  </xsd:complexType>
               </xsd:element>
               <xsd:element name="RecordDataList" minOccurs="0">
                  <xsd:complexType>
                     <xsd:annotation>
                        <xsd:documentation>Defines a list of Data Records in a
submodule.</xsd:documentation>
                     </xsd:annotation>
                     <xsd:sequence>
                        <xsd:element ref="ParameterRecordDataItem" minOccurs="0"
maxOccurs="unbounded"/>
                     </xsd:sequence>
                  </xsd:complexType>
               </xsd:element>
               <xsd:element name="ModuleInfo" type="ModuleInfoT" minOccurs="0"/>
               <xsd:element name="Graphics" type="GraphicsReferenceT" minOccurs="0"/>
            </xsd:sequence>
            <xsd:attribute name="SubmoduleIdentNumber" use="required">
               <xsd:simpleType>
                  <xsd:restriction base="xsd:normalizedString">
                     <xsd:pattern value="0x[0-9,a-f,A-F]{1,8}"/>
                  </xsd:restriction>
               </xsd:simpleType>
            </xsd:attribute>
         </xsd:extension>
      </xsd:complexContent>
   </xsd:complexType>
</xsd:element>
<!--_____________________________________________________________-->
<!-- *** RecordData related ***-->
<xsd:complexType name="ParameterRecordDataT" mixed="true">
   <xsd:sequence>
      <xsd:element name="Name" type="base:LocalizableTextParameterT"/>
      <xsd:element name="Const" minOccurs="0" maxOccurs="unbounded">
         <xsd:complexType mixed="true">
            <xsd:attribute name="ByteOffset" type="base:unsigned32T" use="optional" default="0"/>
            <xsd:attribute name="Data" use="required">
               <xsd:simpleType>
                  <xsd:restriction base="xsd:normalizedString">
                     <xsd:pattern value="(0x[0-9,a-f,A-F][0-9,a-f,A-F],?){1,}"/>
                  </xsd:restriction>
               </xsd:simpleType>
            </xsd:attribute>
         </xsd:complexType>
      </xsd:element>
      <xsd:element name="Ref" type="ValueItemReferenceT" minOccurs="0" maxOccurs="unbounded"/>
   </xsd:sequence>
   <xsd:attribute name="Index" type="base:unsigned16T" use="required"/>
   <xsd:attribute name="Length" type="base:unsigned32T" use="required"/>
   <xsd:attribute name="TransferSequence" type="base:unsigned16T" use="optional" default="0"/>
</xsd:complexType>
<xsd:element name="ParameterRecordDataItem" type="ParameterRecordDataT">
   <xsd:annotation>
      <xsd:documentation>This defines a ParameterRecordData element.</xsd:documentation>
   </xsd:annotation>
</xsd:element>
<!--_____________________________________________________________-->
<!--  *** Multiply used types ***-->
<xsd:complexType name="ValueItemReferenceT">
   <xsd:attribute name="ValueItemTarget" type="xsd:string" use="optional"/>
   <xsd:attribute name="ByteOffset" type="base:unsigned32T" use="required"/>
   <xsd:attribute name="BitOffset" use="optional" default="0">
      <xsd:simpleType>
         <xsd:restriction base="xsd:normalizedString">
            <xsd:pattern value="[0-7]"/>
         </xsd:restriction>
      </xsd:simpleType>
   </xsd:attribute>
   <xsd:attribute name="BitLength" type="base:unsigned8T" use="optional" default="1"/>
   <xsd:attribute name="DataType" type="base:DataTypeEnumT" use="required"/>
   <xsd:attribute name="AllowedValues" type="base:SignedValueListT" use="optional"/>
   <xsd:attribute name="DefaultValue" use="required">
      <xsd:simpleType>
         <xsd:restriction base="xsd:normalizedString">
            <xsd:pattern value="\-?[\d+]{1,20}"/>
         </xsd:restriction>
```

```
         </xsd:simpleType>
      </xsd:attribute>
      <xsd:attribute name="Changeable" type="xsd:boolean" use="optional" default="true"/>
      <xsd:attribute name="Visible" type="xsd:boolean" use="optional" default="true"/>
      <xsd:attribute name="TextId" type="xsd:token" use="required"/>
   </xsd:complexType>
   <xsd:complexType name="GraphicsReferenceT">
      <xsd:annotation>
         <xsd:documentation>This type is used for as a reference to one or more items of  the global
graphics list.</xsd:documentation>
      </xsd:annotation>
      <xsd:sequence>
         <xsd:element name="GraphicItemRef" maxOccurs="unbounded">
            <xsd:complexType>
               <xsd:attribute name="Type" type="base:GraphicsTypeEnumT" use="required"/>
               <xsd:attribute name="GraphicItemTarget" type="xsd:string" use="required"/>
            </xsd:complexType>
         </xsd:element>
      </xsd:sequence>
   </xsd:complexType>
   <xsd:complexType name="ModuleInfoT">
      <xsd:annotation>
         <xsd:documentation>Contains general information about a Module.</xsd:documentation>
      </xsd:annotation>
      <xsd:sequence>
         <xsd:element name="Name" type="base:LocalizableTextParameterT"/>
         <xsd:element name="InfoText" type="base:LocalizableTextParameterT"/>
         <xsd:element name="Family" type="base:FamilyT" minOccurs="0"/>
         <xsd:element name="VendorName" type="base:TokenParameterT" minOccurs="0"/>
         <xsd:element name="OrderNumber" type="base:TokenParameterT" minOccurs="0"/>
         <xsd:element name="HardwareRelease" type="base:TokenParameterT" minOccurs="0"/>
         <xsd:element name="SoftwareRelease" type="base:TokenParameterT" minOccurs="0"/>
      </xsd:sequence>
      <xsd:attribute name="CategoryRef" type="xsd:string" use="optional"/>
      <xsd:attribute name="SubCategory1Ref" type="xsd:string" use="optional"/>
   </xsd:complexType>
   <xsd:complexType name="VirtualSubmoduleListT">
      <xsd:annotation>
         <xsd:documentation>Defines a submodule list used in the module.</xsd:documentation>
      </xsd:annotation>
      <xsd:sequence>
         <xsd:element ref="VirtualSubmoduleItem"/>
      </xsd:sequence>
   </xsd:complexType>
   <xsd:complexType name="DataItemT" mixed="true">
      <xsd:annotation>
         <xsd:documentation>Represents the DataItem used to define the input or output data of a
submodule.</xsd:documentation>
      </xsd:annotation>
      <xsd:attribute name="DataType" type="base:DataItemTypeEnumT" use="required"/>
      <xsd:attribute name="Length" type="base:unsigned16T" use="optional"/>
      <xsd:attribute name="UseAsBits" type="xsd:boolean" use="optional" default="false"/>
      <xsd:attribute name="TextId" type="xsd:token" use="required"/>
   </xsd:complexType>
   <xsd:complexType name="ExternalTextT">
      <xsd:attribute name="TextId" type="xsd:string" use="required"/>
      <xsd:attribute name="Value" type="xsd:string" use="required"/>
   </xsd:complexType>
   <!--________________________________________________________-->
   <!-- *** Profile Header Data Types ***-->
   <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>
   <!--_____________________________________________________________-->
   <!-- *** DeviceProfile Data Types ***-->
   <xsd:complexType name="ProfileHandle_DataType">
      <xsd:sequence>
         <xsd:element name="ProfileIdentification" type="xsd:string"/>
         <xsd:element name="ProfileRevision" type="xsd:string"/>
         <xsd:element name="ProfileLocation" type="xsd:anyURI" minOccurs="0"/>
      </xsd:sequence>
   </xsd:complexType>
</xsd:schema>
```

D.5.3 GSDML communication network profile schema (GSDML-CommNetwork-v1.0.xsd)

```
<?xml version="1.0" encoding="UTF-8"?>
<xsd:schema targetNamespace="http://www.profibus.com/GSDML/2003/11/CommNetworkProfile"
xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns="http://www.profibus.com/GSDML/2003/11/CommNetworkProfile" version="1.0">
   <!--_____________________________________________________________-->
   <!-- *** ISO 15745 Profile definition ***-->
   <xsd:element name="ISO15745Profile">
      <xsd:complexType>
         <xsd:sequence>
            <xsd:element ref="ProfileHeader"/>
            <xsd:element ref="ProfileBody"/>
         </xsd:sequence>
      </xsd:complexType>
   </xsd:element>
   <!--_____________________________________________________________-->
   <!-- *** ProfileHeader ***-->
   <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"/>
            <xsd:element name="ISO15745Reference" type="ISO15745Reference_DataType"/>
            <xsd:element name="IASInterfaceType" type="IASInterface_DataType" minOccurs="0"
maxOccurs="unbounded"/>
         </xsd:sequence>
      </xsd:complexType>
   </xsd:element>
   <!--_____________________________________________________________-->
   <!-- *** ProfileBody ***-->
```

```
   <xsd:element name="ProfileBody">
      <xsd:complexType>
         <xsd:sequence>
            <xsd:element ref="ApplicationLayers"/>
            <xsd:element ref="TransportLayers"/>
         </xsd:sequence>
      </xsd:complexType>
   </xsd:element>
   <!--_____________________________________________________________-->
   <!-- *** Application Layer related *** -->
   <xsd:element name="ApplicationLayers"/>
   <!--_____________________________________________________________-->
   <!-- ***Transport Layer related *** -->
   <xsd:element name="TransportLayers"/>
   <!--_____________________________________________________________-->
   <!-- *** Profile Header Data Types ***-->
   <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:schema>
```

D.5.4 GSDML primitives schema (GSDML-Primitives-v1.0.xsd)

```
<?xml version="1.0" encoding="UTF-8"?>
<xsd:schema targetNamespace="http://www.profibus.com/GSDML/2003/11/Primitives"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns="http://www.profibus.com/GSDML/2003/11/Primitives"
version="1.0">
   <xsd:import namespace="http://www.w3.org/XML/1998/namespace" schemaLocation="xml.xsd"/>
   <!--_____________________________________________________________-->
   <!-- *** Base Data Types for GSDML Device Description ***-->
   <!--_____________________________________________________________-->
   <!-- *** Object definition for GSDML ***-->
   <xsd:complexType name="ObjectT">
```

```
      <xsd:annotation>
         <xsd:documentation>Base definition for objects which can be referred.</xsd:documentation>
      </xsd:annotation>
      <xsd:attribute name="ID" type="IdT" use="required"/>
   </xsd:complexType>
   <xsd:simpleType name="IdT">
      <xsd:annotation>
         <xsd:documentation> Base type for object IDs. Any string without whitespaces at the
beginning and end is allowed.</xsd:documentation>
      </xsd:annotation>
      <xsd:restriction base="xsd:string">
         <xsd:pattern value="(\S(.)*\S)|\S"/>
      </xsd:restriction>
   </xsd:simpleType>
   <xsd:simpleType name="ValueListT">
      <xsd:annotation>
         <xsd:documentation>Base type for a list including ranges of unsigned
values</xsd:documentation>
      </xsd:annotation>
      <xsd:restriction base="xsd:string">
         <xsd:pattern value="((\d+\.\.\d+)|(\d+))(( \d+\.\.\d+)|( \d+))*"/>
      </xsd:restriction>
   </xsd:simpleType>
   <xsd:simpleType name="SignedValueListT">
      <xsd:annotation>
         <xsd:documentation>Base type for a list including ranges of signed
values</xsd:documentation>
      </xsd:annotation>
      <xsd:restriction base="xsd:string">
         <xsd:pattern value="((\-?\d+\.\.\-?\d+)|(\-?\d+))(( \-?\d+\.\.\-?\d+)|( \-?\d+))*"/>
      </xsd:restriction>
   </xsd:simpleType>
   <xsd:complexType name="TokenParameterT">
      <xsd:annotation>
         <xsd:documentation/>
      </xsd:annotation>
      <xsd:attribute name="Value" type="xsd:token" use="required"/>
   </xsd:complexType>
   <!--_____________________________________________________________-->
   <!-- *** Specialized Data Types from Primitives schema ***-->
   <xsd:complexType name="LocalizableTextParameterT">
      <xsd:attribute name="TextId" type="xsd:token" use="required"/>
   </xsd:complexType>
   <!--_____________________________________________________________-->
   <!-- *** Data Type aliases to map former GSD Datatypes ***-->
   <xsd:simpleType name="unsigned8T">
      <xsd:restriction base="xsd:unsignedByte"/>
   </xsd:simpleType>
   <xsd:simpleType name="unsigned16T">
      <xsd:restriction base="xsd:unsignedShort"/>
   </xsd:simpleType>
   <xsd:simpleType name="unsigned32T">
      <xsd:restriction base="xsd:unsignedInt"/>
   </xsd:simpleType>
   <!--_____________________________________________________________-->
   <!-- *** Data Type for enumerations ***-->
   <xsd:complexType name="FamilyT">
      <xsd:annotation>
         <xsd:documentation>Sets the Device family for identification purpose.</xsd:documentation>
      </xsd:annotation>
      <xsd:attribute name="MainFamily" type="FamilyEnumT" use="required"/>
      <xsd:attribute name="ProductFamily" type="xsd:normalizedString" use="optional"/>
   </xsd:complexType>
   <xsd:simpleType name="FamilyEnumT">
      <xsd:annotation>
         <xsd:documentation>Defines the possible settings for Family/MainFamily.</xsd:documentation>
      </xsd:annotation>
      <xsd:restriction base="xsd:string">
         <xsd:enumeration value="General"/>
         <xsd:enumeration value="Drives"/>
         <xsd:enumeration value="Switching Devices"/>
         <xsd:enumeration value="I/O"/>
         <xsd:enumeration value="Valves"/>
         <xsd:enumeration value="Controllers"/>
         <xsd:enumeration value="HMI"/>
         <xsd:enumeration value="Encoders"/>
```

```
            <xsd:enumeration value="NC/RC"/>
            <xsd:enumeration value="Gateway"/>
            <xsd:enumeration value="PLCs"/>
            <xsd:enumeration value="Ident Systems"/>
            <xsd:enumeration value="PA Profiles"/>
         </xsd:restriction>
      </xsd:simpleType>
      <xsd:simpleType name="GraphicsTypeEnumT">
         <xsd:annotation>
            <xsd:documentation>This is a list of possible types of a graphic representation of a module
or submodule.</xsd:documentation>
         </xsd:annotation>
         <xsd:restriction base="xsd:string">
            <xsd:enumeration value="DeviceSymbol"/>
            <xsd:enumeration value="DeviceIcon"/>
         </xsd:restriction>
      </xsd:simpleType>
      <xsd:simpleType name="DataItemTypeEnumT">
         <xsd:annotation>
            <xsd:documentation>Defines the possible Datatypes for DataItems</xsd:documentation>
         </xsd:annotation>
         <xsd:restriction base="xsd:string">
            <xsd:enumeration value="Integer8"/>
            <xsd:enumeration value="Integer16"/>
            <xsd:enumeration value="Integer32"/>
            <xsd:enumeration value="Integer64"/>
            <xsd:enumeration value="Unsigned8"/>
            <xsd:enumeration value="Unsigned16"/>
            <xsd:enumeration value="Unsigned32"/>
            <xsd:enumeration value="Unsigned64"/>
            <xsd:enumeration value="Float32"/>
            <xsd:enumeration value="Float64"/>
            <xsd:enumeration value="Date"/>
            <xsd:enumeration value="TimeOfDay with date indication"/>
            <xsd:enumeration value="TimeOfDay without date indication"/>
            <xsd:enumeration value="TimeDifference with date indication"/>
            <xsd:enumeration value="TimeDifference without date indication"/>
            <xsd:enumeration value="NetworkTime"/>
            <xsd:enumeration value="NetworkTimeDifference"/>
            <xsd:enumeration value="VisibleString"/>
            <xsd:enumeration value="OctetString"/>
         </xsd:restriction>
      </xsd:simpleType>
      <xsd:simpleType name="IODataConsistencyEnumT">
         <xsd:annotation>
            <xsd:documentation>Specifies the consistency behaviour </xsd:documentation>
         </xsd:annotation>
         <xsd:restriction base="xsd:string">
            <xsd:enumeration value="Item consistency"/>
            <xsd:enumeration value="All items consistency"/>
         </xsd:restriction>
      </xsd:simpleType>
      <xsd:simpleType name="DataTypeEnumT">
         <xsd:restriction base="xsd:string">
            <xsd:enumeration value="Bit"/>
            <xsd:enumeration value="BitArea"/>
            <xsd:enumeration value="Integer8"/>
            <xsd:enumeration value="Integer16"/>
            <xsd:enumeration value="Integer32"/>
            <xsd:enumeration value="Integer64"/>
            <xsd:enumeration value="Unsigned8"/>
            <xsd:enumeration value="Unsigned16"/>
            <xsd:enumeration value="Unsigned32"/>
            <xsd:enumeration value="Unsigned64"/>
         </xsd:restriction>
      </xsd:simpleType>
   </xsd:schema>
```

Page 125, Bibliography

Add the following to the list of bibliographic references:

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