IEC 62769-101-2

Edition 2.0 2020-11
REDLINE VERSION

INTERNATIONAL STANDARD

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Field device integration (FDI) –
Part 101-2: Profiles – Foundation Fieldbus HSE

IEC 62769-101-2:2020-11 RLV(en)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ICS 25.040.40; 35.100.05

ISBN 978-2-8322-9105-4

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FIELD DEVICE INTEGRATION (FDI) –

Part 101-2: Profiles – Foundation Fieldbus HSE

FOREWORD

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International Standard IEC 62769-101-2 has been prepared by subcommittee 65E: Devices and integration in enterprise systems, of IEC technical committee 65: Industrial-process measurement, control and automation.

This second edition cancels and replaces the first edition published in 2015. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) support for generic protocol extension for faster adoption of other technologies;
b) support for Package developers to build EDDs targeted for today's EDD bases system under a single development tool.

The text of this International Standard is based on the following documents:

CDV	Report on voting
65E/621/CDV	65E/684/RVC

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 62769 series, published under the general title *Field device integration (FDI)*, can be found on the IEC website.

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INTRODUCTION

The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of patents concerning

a) Method for the Supplying and Installation of Device-Specific Functionalities, see Patent Family DE10357276;

b) Method and device for accessing a functional module of automation system, see Patent Family EP2182418;

c) Methods and apparatus to reduce memory requirements for process control system software applications, see Patent Family US2013232186 ;

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FIELD DEVICE INTEGRATION (FDI) –

Part 101-2: Profiles – Foundation Fieldbus HSE

1 Scope

This part of IEC 62769 specifies the IEC 62769 profile for IEC 61784-1, CP 1/2 (FOUNDATION™ Fieldbus HSE)[1].

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61784-1, *Industrial communication networks – Profiles – Part 1: Fieldbus Profiles*

IEC 61784-2, *Industrial communication networks – Profiles – Part 2: Additional fieldbus profiles for real-time networks based on ISO/IEC/IEEE 8802-3*

IEC 61804 (all parts), *Function blocks (FB) for process control and electronic device description language (EDDL)*

IEC 62541-6, *OPC unified architecture – Part 6: Mappings*

IEC 62541-100:2015, *OPC unified architecture – Part 100: Device Interface*

IEC 62769-2, *Field Device Integration (FDI) – Part 2: FDI Client*

~~NOTE IEC 62769-2 is technically identical to FDI-2022.~~

IEC 62769-3, *Field Device Integration (FDI) – Part 3: FDI Server*

~~NOTE IEC 62769-3 is technically identical to FDI-2023.~~

IEC 62769-4, *Field Device Integration (FDI) – Part 4: FDI Packages*

~~NOTE IEC 62769-4 is technical identically to FDI-2024.~~

IEC 62769-5, *Field Device Integration (FDI) – Part 5: FDI Information Model*

~~NOTE IEC 62769-5 is technical identically to FDI-2025.~~

IEC 62769-6, *Field Device Integration (FDI) – Part 6: FDI Technology Mapping*

~~NOTE IEC 62769-6 is technical identically to FDI-2026.~~

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1 FOUNDATION™ Fieldbus is the trade name of the non-profit consortium Fieldbus Foundation. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the trademark holder or any of its products. Compliance does not require use of the trade name. Use of the trade name requires permission of the trade name holder.

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IEC 62769-7, *Field Device Integration (FDI) – Part 7: FDI Communication Devices*

~~NOTE IEC 62769-7 is technical identically to FDI-2027.~~

IEC 62769-101-1, *Field Device Integration (FDI) – Part 101-1: Profiles – Foundation Fieldbus H1*

3 Terms, definitions, abbreviated terms and ~~acronyms~~ conventions

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61784-1, IEC 61784-2, IEC 61804 (all parts), IEC 62541-100, IEC 62769-2, IEC 62769-3, IEC 62769-4, IEC 62769-5, IEC 62769-6, IEC 62769-7 and IEC 62769-101-1 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.2 Abbreviated terms ~~and acronyms~~

For the purposes of this document, the following abbreviated terms apply:

CFF common file format
CP communication profile (see IEC 61784-1 or IEC 61784-2)
CPF communication profile family (see IEC 61784-1 or IEC 61784-2)
EDD Electronic Device Description (see IEC 61804 (all parts))
FB Function Block
IM Information Model
SMIB System Management Information Base
VFD virtual field device

3.3 Conventions

3.3.1 EDDL syntax

This document specifies content for the EDD component that is part of FDI Communication Packages. EDDL syntax uses the font `Courier New`. EDDL syntax is used for method signature, variable, data structure and component declarations.

3.3.2 XML syntax

XML syntax examples use the font `Courier New`. The XML syntax is used to describe XML document schema.

EXAMPLE `<xsd:simpleType name="Example">`

4 Profile for CP 1/2 (FOUNDATION™ HSE)

4.1 General

This profile ~~annex~~ specifies the protocol specifics needed for FDI Packages describing communication servers, gateways and devices. Requirements for Direct Access transfer service parameters are given in Annex B.

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4.2 Catalog profile

4.2.1 Protocol support files

~~5.2.1.1 Capability file~~

Each CP 1/2 FDI Device Package shall contain a capability file. The capability file part is described in Table 1.

Table 1 – Capability File part

Parameter	Description
Content Type	txt/plain
Root Namespace	Not applicable
Source Relationship	http://fdi-cooperation.com/2010/relationships/attachment-protocol
Filename	Use file extension .CFH

4.2.2 CommunicationProfile definition

IEC 62769-4 defines a ~~CommunicationProfile enumeration~~ CommunicationProfileT string type for the Catalog XML schema. Table 2 defines the CP 1/2 specific values for this ~~enumeration~~ string.

Table 2 – CommunicationProfile definition

CommunicationProfile	Description
foundation_hse	CP 1/2 device type

4.2.3 Profile device

Not supported in this document.

4.2.4 Protocol version information

IEC 62769-4 defines an element type named InterfaceT for the Catalog XML Schema. Element type InterfaceT contains an element named Version which is supposed to provide version information about the applied communication protocol profile. The value follows the IEC 62769-4 defined version information schema defined in element type VersionT.

The major version part of VersionT shall be set to the ITK_VER parameter. The minor and builds parts shall be set to 0.

EXAMPLE For ITK_VER 5, the value for InterfaceT is 5.0.0.

4.3 Associating a Package with a CP 1/2 device

4.3.1 Device type identification mapping

CP 1/2 device types are uniquely identified by the parameters MANUFAC_ID, DEVICE_TYPE and DEV_REV found in the Resource Block of the Function Block VFD. These parameters are used to associate a given device instance to an FDI Device Package. These parameters are mapped to the FDI Device Package Catalog according to Table 3.

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Table 3 – Device type catalog mapping

Catalog Element	CP Mapping
Manufacturer element of InterfaceT (IEC 62769-4)	MANUFAC_ID String format "0xdddd" where dddd is the MANUFAC_ID number in hexadecimal format.
DeviceModel element of InterfaceT String format "0xdddd" where dddd is the DEVICE_TYPE number in hexadecimal format. (IEC 62769-4)	DEVICE_TYPE String format "0xdddd" where dddd is the DEVICE_TYPE number in hexadecimal format.
DeviceRevision element ListOfSupportedDeviceRevisionsT (IEC 62769-4)	DEV_REV [a] String format "x.0.0" where x is the DEV_REV in decimal format (no leading zeros).
[a] Conditional: Shall be available if the device exposes a Function Block VFD.	

4.3.2 Device type revision mapping

Each device type is identified per 4.3.1. A device may also include a parameter COMPATIBILITY_REV from the Resource Block. This parameter specifies the lowest device version (DEV_REV) that a new device can replace while maintaining compatibility with a prior FDI Device Package.

4.4 Information Model mapping

4.4.1 ProtocolType definition

Table 4 defines the ProtocolType used to identify CP 1/2 network communications.

Table 4 – ProtocolType Foundation_HSE definition

Attribute	Value				
BrowseName	Foundation_HSE				
IsAbstract	False				
References	**NodeClass**	**BrowseName**	**DataType**	**TypeDefinition**	**ModellingRule**
Inherits the properties of ProtocolType defined in IEC 62541-100.					

4.4.2 DeviceType mapping

Each device type inherits the properties of DeviceType. The mapping of the inherited properties from DeviceType is defined in Table 5.

Table 5 – Inherited DeviceType property mapping

Property	CP Mapping
SerialNumber	DEV_ID (System Management Information Base)
RevisionCounter	−1 (not defined)
Manufacturer	~~MANUFAC_ID (Resource Block)~~ String obtained from FDI package catalog (ManufacturerName from PackageT)
Model	~~DEV_TYPE (Resource Block)~~ String obtained from FDI package catalog (Name of DeviceTypeT, which is a localized name)
DeviceManual	entry text string (not supported) [a]

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Property	CP Mapping
DeviceRevision	DEV_REV (Resource Block) [b]
SoftwareRevision	SOFTWARE_REV (if available, otherwise ~~–1~~ empty string)
HardwareRevision	HARDWARE_REV (if available, otherwise ~~–1~~ empty string)
[a] Device manuals are exposed as attachments of the FDI Device Package. [b] Conditional: Shall be available if the device exposes a Function Block VFD.	

4.4.3 FunctionalGroup Identification definition

As defined in IEC 62541-100, each device representation in the FDI Server hosted Information Model shall contain a protocol specific FunctionalGroup called Identification. This FunctionalGroup organizes variables found in the Resource Block of the device type instance. The FunctionalGroup Identification for CP 1/2 is defined in Table 6.

Table 6 – Identification parameters

BrowseName	VariableType	Optional/Mandatory
MANUFAC_ID	UInt32	Mandatory
DEV_TYPE	UInt16	Mandatory
DEV_REV	UInt8	~~Mandatory~~ Conditional [a]
HARDWARE_REV	String	Optional
SOFTWARE_REV	String	Optional
COMPATIBILITY_REV	UInt8	Optional
CAPABILITY_LEV	UInt8	Optional
ITK_VER	UInt16	~~Mandatory~~ Conditional [a]
SIF_ITK_VER	UInt16	Optional
FD_VER	UInt16	Optional
[a] Conditional: Shall be available if the device exposes a Function Block VFD.		

4.4.4 BlockType property mapping

CP 1/2 device types are block-oriented according to IEC 62541-100. IEC 62769-5 specifies the mapping of EDDL BLOCK_A elements to block types and instances.

The BLOCK_A maps as a subtype of the topology element BlockType and inherits the properties as per IEC 62541-100. The mapping of the inherited properties of BlockType is specified in Table 7.

Table 7 – Inherited BlockType property mapping

Property	CP Mapping (Block's ParameterSet)
RevisionCounter	ST_REV
ActualMode	MODE_BLK.ACTUAL
PermittedMode	MODE_BLK.PERMITTED
NormalMode	MODE_BLK.NORMAL
TargetMode	MODE_BLK.TARGET

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4.4.5 Mapping to Block ParameterSet

The ParameterSet is relative to each Block. The ParameterSet includes the CHARACTERISTICS records of the block that contains all the parameters found in the PARAMETERS, LOCAL_PARAMETERS and LIST_ITEMS.

The browse name of the parameters found in the PARAMETERS and LOCAL_PARAMETERS is the member name in the respective lists. For example, ST_REV is the browse name of the Static Revision parameter. LIST_ITEMS do not have member names; therefore, the browse name of each LIST in the LIST_ITEMS is the item name of the list.

4.5 Topology elements

4.5.1 ConnectionPoint definition

The ConnectionPoint type ConnectionPoint_Foundation_HSE shall be used to identify CP 1/2 network communication and is defined in Table 8. The ConnectionPoint_Foundation_HSE type is a sub type of the abstract type ConnectionPointType defined in IEC 62541-100.

The Address property can be an IPv4 or IPv6 address. For IPv4 addresses, the address shall be stored in the last 4 octets and all other octets shall be set to zero.

The OrdinalNumber property reflects the position of the VFD within the SMIB VFD list. For devices exposing multiple FB VFDs, the OrdinalNumber property is mandatory to address the FB VFD. For devices with a single FB VFD the OrdinalNumber property can be omitted. Devices exposed as instances of type DeviceType define their Connection points as components. Hence Devices with multiple FB VFDs shall contain multiple Connection points, one per FB VFD.

Table 8 – ConnectionPointType ConnectionPoint_Foundation_HSE definition

Attribute	Value				
BrowseName	ConnectionPoint_Foundation_HSE				
IsAbstract	False				
References	**NodeClass**	**BrowseName**	**DataType**	**TypeDefinition**	**ModellingRule**
Inherits the properties of ConnectionPointType defined in IEC 62541-100.					
HasProperty	Variable	Address	Octet[16]	PropertyType	Mandatory
HasProperty	Variable	OrdinalNumber	Int32	PropertyType	Optional

The ConnectionPoint type ConnectionPoint_Foundation_HSE shall be described by an EDD element contained in a Communication Device related FDI Package that can drive a CP 1/2 network. Actual ConnectionPoint_ConnectionPoint properties are declared by VARIABLE constructs grouped together in a COLLECTION named Foundation_HSE_ConnectionPoint_Properties.

```
COMPONENT ConnectionPoint_Foundation_HSE
{
  LABEL "Foundation HSE Connection point";
  CLASSIFICATION NETWORK_CONNECTION_POINT;
  CAN_DELETE FALSE;
  PROTOCOL Foundation_HSE;
  CONNECTION_POINT Foundation_HSE_ConnectionPoint_Properties;
}
```

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```
VARIABLE Address
{
  LABEL "Address";
  HELP "Address";
  CLASS DEVICE;
  TYPE OCTET(16);
  HANDLING READ & WRITE;
}

VARIABLE OrdinalNumber
{
  LABEL "OrdinalNumber address property";
  HELP "OrdinalNumber property to address the Function Block
Application";
  CLASS DEVICE;
  TYPE UNSIGNED_INTEGER (4);
  HANDLING READ & WRITE;
}

COLLECTION Foundation_HSE_ConnectionPoint_Properties
{
  LABEL "Foundation HSE Connection Point data";
  MEMBERS
  {
    CONNECTION_POINT_ADDRESS, Address;
    CONNECTION_POINT_ORDINALNUMBER, OrdinalNumber;
  }
}
```

4.5.2 Communication Device definition

According to IEC 62769-7, each FDI Communication Package shall contain an EDD element describing the device. The following EDDL source code is an example describing an FDI Communication Server.

```
COMPONENT Foundation_HSE_Communication_Server
{
  LABEL "Foundation HSE communication server",
  PRODUCT_URI "urn:Fieldbus Foundation:Foundation HSE Communication
Server";
  CAN_DELETE TRUE;
  CLASSIFICATION NETWORK_COMPONENT;
  COMPONENT_RELATIONS
  {
    Foundation_HSE_Communication_Device_Setup
  }
}

COMPONENT_RELATION Foundation_HSE_Communication_Device_Setup
{
  LABEL "Relation between Device and communication device";
  RELATION_TYPE CHILD_COMPONENT;
  COMPONENTS
  {
    Foundation_HSE_Communication_Device{AUTO_CREATE 1;}
  }
  MINIMUM_NUMBER 1;
  MAXIMUM_NUMBER 1;
}
```

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Semantics of the EDDL constructs shown above are described in IEC 62769-7. The EDDL COMPONENT will be utilized by the FDI Server and FDI Communication Server to create an instance of type CommunicationServerType as described in IEC 62769-7.

According to IEC 62769-7, each FDI Communication Package shall contain at least one EDD element describing at least one CommunicationDevice component. The following EDDL source code is an example for a communication device.

```
COMPONENT Foundation_HSE_Communication_Device
{
  LABEL "Foundation HSE communication device";
  CAN_DELETE TRUE;
  CLASSIFICATION NETWORK_COMPONENT;
  COMPONENT_RELATIONS
  {
    Foundation_HSE_Service_Provider_Relation
  }
}

COMPONENT_RELATION Foundation_HSE_Service_Provider_Relation
{
  LABEL "Foundation HSE communication service provider";
  RELATION_TYPE CHILD_COMPONENT;
  COMPONENTS
  {
    Foundation_HSE_Service_Provider{AUTO_CREATE 1;}
  }
  MINIMUM_NUMBER 1;
  MAXIMUM_NUMBER 16;
}
```

Semantics of the EDDL constructs shown above are described in IEC 62769-7. The EDDL COMPONENT will be utilized by the FDI server and FDI Communication Server to create an instance of type ServerCommunicationDeviceType as described in IEC 62769-7.

The instance of type ServerCommunicationDeviceType shall contain the following parameter(s) with its/their ParameterSet. Table 9 shows definition of the Communication device ParameterSet.

Table 9 – Communication device ParameterSet definition

Attribute	Value				
BrowseName	ParameterSet				
References	**NodeClass**	**BrowseName**	**DataType**	**TypeDefinition**	**ModellingRule**
See IEC 62541-100:2015, 5.2.					
HasTypeDefinition	ObjectType	BaseObjectType			
HasComponent	Variable	<ParameterIdentifier>		BaseDataVariableType	Mandatory-Placeholder

4.5.3 Communication service provider definition

According to IEC 62769-7, each FDI Communication Package shall contain at least one EDD element describing at least one communication service provider component. The following EDDL source code is an example for a CP 1/2 communication service provider component.

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The component reference ConnectionPoint_Foundation_HSE corresponds to the related Connection Point definition in ~~5.4.2~~ 4.5.1.

```
COMPONENT Foundation_HSE_Service_Provider
{
  LABEL "Foundation HSE communication service provider";
  CAN_DELETE FALSE;
  CLASSIFICATION NETWORK_COMMUNICATION_SERVICE_PROVIDER;
  COMPONENT_RELATIONS
  {
    Foundation_HSE_Connection_Point_Relation
  }
  BYTE_ORDER BIG_ENDIAN;
}

COMPONENT_RELATION
Foundation_HSE_Service_Provider_Connection_Point_Relation
{
  LABEL "Relation between communication service provider and
connection point";
  RELATION_TYPE CHILD_COMPONENT;
  ADDRESSING {Address}
  COMPONENTS
  {
    ConnectionPoint_Foundation_HSE{ AUTO_CREATE 1;}
  }
  MINIMUM_NUMBER 1;
  MAXIMUM_NUMBER 1;
}
```

Semantics of the EDDL constructs shown above are described in IEC 62769-7. The EDDL COMPONENT will be utilized by the FDI Server and FDI Communication Server to create an instance of type ServerCommunicationServiceType as described in IEC 62769-7.

4.5.4 Network definition

According to IEC 62769-7, each FDI Communication Package shall contain at least one EDD element describing one Network for each of the protocols that are supported by the Communication Device. The definition supports the network topology engineering.

```
COMPONENT Network_Foundation_HSE
{
  LABEL "Foundation HSE Network";
  CAN_DELETE TRUE;
  CLASSIFICATION NETWORK;
  COMPONENT_RELATIONS
  {
    Foundation_HSE_Network_Connection_Point_Relation
  }

COMPONENT_RELATION Foundation_HSE_Network_Connection_Point_Relation
{
  LABEL "Relation between network and connection point";
  RELATION_TYPE CHILD_COMPONENT;
  ADDRESSING {Address}
  COMPONENTS
  {
    ConnectionPoint_Foundation_HSE
  }
  MINIMUM_NUMBER 1;
```

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```
  MAXIMUM_NUMBER 32;
}
```

Semantics of the EDDL constructs shown above are described in IEC 62769-7. The EDDL COMPONENT will be utilized by the FDI server and FDI Communication Server to create an instance of type NetworkType as described with IEC 62541-100.

4.6 Methods

4.6.1 Methods for FDI Communication Servers

4.6.1.1 General

The Communication Server shall implement services according to the method signatures described in 4.6.1 and according to the Information Model.

4.6.1.2 Connect

Table 10 shows the Method Connect arguments.

Signature:

```
Connect(
    [in]   ByteString        CommunicationRelationId,
    [in]   ByteString        Address,
    [in]   Int32             OrdinalNumber,
    [in]   UInt32            ServiceID,
    [out]  UInt32            DelayForNextCall,
    [out]  Int32             ServiceError);
```

Table 10 – Method Connect arguments

Argument	Description
CommunicationRelationId	The argument value contains the nodeId of the Device ConnectionPoint representing the connection between a device and a physical network directly connected to the FDI Communication Server hardware. The nodeId allows to find the direct parent-child relation.
Address	The argument name shall match with the corresponding attribute name defined for the ConnectionPoint which is described by a corresponding EDD element specified in 5.4.2 4.5.1. The argument value holds the device's IPv4 or IPv6 address.
OrdinalNumber	The argument name shall match with the corresponding attribute name defined for the ConnectionPoint which is described by a corresponding EDD element specified in 5.4.2 4.5.1. The argument value holds the OrdinalNumber. The OrdinalNumber is the position of the VFD within the SMIB VFD list. If a value 0 is passed with this argument the first FB VFD is selected.
ServiceId	The service transaction code establishes the relation between the service request and the corresponding response.
DelayForNextCall	The value specifies a delay time in ms to limit the EndConnect invocation cycle that shall not be faster than specified in the argument value.

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Argument	Description
ServiceError	~~0: OK / function started asynchronously, result has to be polled with EndConnect~~ ~~1: OK / execution finished, connection established successfully~~ 0: OK/execution finished, connection established successfully −1: Connect Failed/canceled by caller −2: Call Failed/unknown service ID −3: Connect Failed/device not found −4: Connect Failed/invalid device node address −5: Connect Failed/invalid device identification −6: Connect Failed/invalid LinkId argument −7: Connect Failed/invalid OrdinalNumber argument
NOTE IEC 62769-7 defines the argument AddressData of the Connect Method as an array of Variant. The address arguments defined with the table are represented as entries of the Variant array in the order they are specified above. IEC 62769-7 defines the argument DeviceInformation as a protocol specific argument list in which the Connect Method stores the resulting data. The DeviceInformation argument is defined as an array of Variant. The DeviceInformation argument is not used.	

4.6.1.3 Disconnect

Table 11 shows the Method Disconnect arguments.

Signature:

```
Disconnect(
    [in]   ByteString        CommunicationRelationId,
    [out]  UInt32            ServiceError);
```

Table 11 – Method Disconect arguments

Argument	Description
CommunicationRelationId	The argument value contains the nodeId of the Device ConnectionPoint representing the connection between a device and a physical network directly connected to the FDI Communication Server hardware. The nodeId allows finding the direct parent-child relation.
ServiceError	~~1: OK / disconnect finished successfully~~ 0: OK/disconnect finished successfully −1: Disconnect Failed/no existing communication relation −2: Disconnect Failed/invalid communication relation identifier

4.6.1.4 Transfer

Table 12 shows the Method Transfer arguments.

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Signature:

```
Transfer(
   [in]   ByteString       CommunicationRelationId,
   [in]   String           OPERATION,
   [in]   String           BlockTag,
   [in]   UInt32           INDEX,
   [in]   UInt32           SUB_INDEX,
   [in]   Byte[]           WriteData,
   [in]   UInt32           ServiceId,
   [out]  Byte[]           ReadData,
   [in]   UInt32           ServiceId,
   [out]  UInt32           DelayForNextCall,
   [out]  Int32            ServiceError);
```

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Table 12 – Method Transfer arguments

Argument	Description
CommunicationRelationId	The argument value contains the nodeId of the ConnectionPoint representing the connection between a device and a physical network within the Information Model.
OPERATION	The argument value indicates the data transfer operation. Allowed values are "READ", "WRITE" and "VIEW_READ".
BlockTag	The argument denotes the Block tag of the block instance being addressed. The value can be obtained by the Method Scan.
INDEX	OPERATION indicates "READ" or "WRITE": The argument denotes the relative index of the block parameter being addressed. The relative index can be calculated by iterating the parameters of a block within the FDI Information Model. A value of 0 addresses the block header record (described by the CHARACTERISTICS attribute within the EDD). The first parameter is addressed with the INDEX 1. OPERATION indicates "VIEW_READ": The argument denotes the view identifier in a range from 1 to 4. For instance a value of 1 requests that View_1 shall be read. Multiple View_3 or View_4 objects are identified by the INDEX and the SUB_INDEX argument.
SUB_INDEX	OPERATION indicates "READ" or "WRITE": The argument denotes the subindex of a member of the block parameter being addressed if the block parameter is of type RECORD or ARRAY. To address a simple parameter, a value of 0 shall be passed with this argument. To address a specific member of a parameter of type RECORD or ARRAY a 1-relative value shall be passed with this argument. To address the parameter of type RECORD or ARRAY as a whole, a value of 0 shall be passed with this argument. OPERATION indicates "VIEW_READ": The argument addresses a View_3 or View_4 if multiple views of that type exist. The argument shall be 0 if there are no multiple views of the type addressed with the INDEX argument. Values of 1 up to the number of views of that type address the specific view.
WriteData	Write data encoded as byte array. Encoding of integers shall follow the rules defined with IEC 62541-6. The argument shall be ignored if OPERATION indicates a read transfer or a view read transfer.
ServiceId	The service transaction code establishes the relation between the service request and the corresponding response.
ReadData	With this argument, the read data byte stream is returned as a byte array. Encoding of integers shall follow the rules defined with IEC 62541-6. The argument shall be ignored if OPERATION indicates a write transfer.

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Argument	Description
~~DelayForNextCall~~	~~The value specifies a delay time in ms to limit the EndTransfer invocation cycle that shall not be faster than specified in the argument value.~~
ServiceError	~~0: OK / function started asynchronously, result has to be polled with EndTransfer~~ ~~1: OK / execution finished, ReceivedData contains the result~~ 0: OK/execution finished −1: Transfer Failed/canceled by caller −2: Call Failed/unknown service ID −3: Transfer Failed/no existing communication relation −4: Transfer Failed/invalid communication relation identifier −5: Transfer Failed/invalid sendData content −6: Transfer Failed/invalid receiveData format −7: Transfer Failed/Parameter Check [a] −8: Transfer Failed/exceeds Parameter Limits [a] −9: Transfer Failed/wrong Mode for Request [a] −10: Transfer Failed/write is prohibited by write lock switch or write lock Function Block for SIS devices [a] −11: Transfer Failed/data value is never writeable [a] −12: Transfer Failed/duplicate BlockTag detected −13: Invalid INDEX, SUB_INDEX argument provided with a "VIEW_READ" transfer
The FDI Server maintains an Information Model as defined in IEC 62541 100. Hence topology elements representing an FFBlockType are separated from actual block instances. An instance called Blocks of a ConfigurableObjectType is used to implement instantiation rules. Instantiation of blocks is further detailed in IEC 62769 5. According to the rules defined in IEC 62769 5, the FDI Server needs to gather information of the FF Directory object in order to be able to create block instances. This information shall be provided by the Scan Method defined with 4.6.1.7. According to IEC 62769 5, the BlockTag argument denoted above is obtained from the DisplayName attribute of the corresponding Block instance within the FDI Information Model.	
NOTE 1 IEC 62769-7, defines the argument SendData of the Transfer Method as an array of Variants. The arguments OPERATION, BlockTag, INDEX, SUB_INDEX and WriteData defined in this Table 12 are represented as entries of the Variant array in the order they are specified above. NOTE 2 IEC 62769-7 defines the argument ReceiveData of the Transfer Method as an array of Variant. The argument ReadData defined with the table is represented as entry of the Variant array in the order specified above. NOTE 3 Example (for clarification): A block has two views of type View_4. The first view of type View_4 is addressed with the arguments INDEX = 4 and SUB_INDEX = 1. The second view is addressed with the arguments INDEX = 4 and SUB_INDEX = 2.	
[a] A ServiceError value may be returned with a write operation.	
See Annex C on a description how the communication service arguments for Transfer Method are obtained from the EDD.	

4.6.1.5 GetPublishedData

CP 1/2 alerts represent unsolicited messages as defined in IEC 62769-7. Table 13 shows the arguments of the Method GetPublishedData.

NOTE CP 1/2 uses the term alerts to refer to alarms and event messages. These are asynchronous, unsolicited messages that deliver state change notifications such as diagnostic conditions. These messages are mapped to the GetPublishData service. CP 1/2 also uses the term publish to refer to synchronous, network scheduled communication for process values. These published messages are not mapped to the GetPublishedData service.

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Signature:

```
GetPublishedData(
    [in] ByteString CommunicationRelationId,
    [out] String BlockTag,
    [out] Byte[] AlarmEventData,
    [out] NodeId AlarmEventType,
    [out] DateTime TimeStamp,
    [in] UInt32 ServiceId,
    [out] UInt32 DelayForNextCall,
    [out] Int32 ServiceError);
```

Table 13 – Method GetPublishedData arguments

Argument	Description
CommunicationRelationId	The argument value contains the nodeId of the ConnectionPoint representing the connection between a device and a physical network within the Information Model.
BlockTag	The output argument denotes the Block tag of the block instance that issued the alarm or event.
AlarmEventData	With this argument the alarm/event data byte stream is returned as a byte array. Encoding of integers shall follow the rules defined in IEC 62541-6.
AlarmEventType	NodeId of the alarm or event type node defined within the FDI Information Model to decode the alarm/event data stream. The alarm and event types shall be read from the EDD by the FDI Server when creating the Information Model.
TimeStamp	Denotes the time the alarm or event was detected by the device.
~~ServiceId~~	~~The service transaction code establishes the relation between the service request and the corresponding response.~~
~~DelayForNextCall~~	~~The value specifies a delay time in ms to limit the EndGetPublishedData invocation~~ ~~cycle that shall not be faster than specified in the argument value.~~
ServiceError	~~0: OK / function started asynchronously, result has to be polled with EndGetPublishedData~~ ~~1: OK / execution finished, ReceivedData and TimeStamp contain the result~~ 0: OK/execution finished −1: GetPublishedData Failed/canceled by caller −2: Call Failed/unknown service ID −3: GetPublishedData Failed/not supported −4: GetPublishedData Failed/no existing communication relation −5: GetPublishedData Failed/invalid communication relation identifier −8: GetPublishedData Failed/no Alarm/Event data published. −9: GetPublishedData Failed/invalid AlarmEventType
The FDI Server maintains an Information Model as defined in IEC 62541-100. Hence topology elements representing an FFBlockType are separated from actual block instances. An instance called Blocks of a ConfigurableObjectType is used to implement instantiation rules. Instantiation of blocks is further detailed in IEC 62769-5. According to the rules defined in IEC 62769-5, the FDI Server needs to gather information of the FF Directory object in order to be able to create block instances. This information shall be provided by the Scan Method defined with 4.6.1.7. According to IEC 62769-5, the BlockTag argument denoted above is obtained from the DisplayName attribute of the corresponding Block instance within the FDI Information Model. A ServiceError value may be returned with a write operation.	

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NOTE 1 IEC 62769-7, defines the argument ReceiveData of the GetPublishedData Method as an array of Variant. The arguments BlockTag, AlarmEventData and AlarmEventType defined in this Table 13 are represented as entries of the Variant array in the order they are specified above.

NOTE 2 IEC 62769-7 defines the argument SendData of the Transfer Method as an array of Variant. The arguments OPERATION, BlockTag, INDEX, SUB_INDEX and WriteData defined in this Table 13 are represented as entries of the Variant array in the order they are specified above.

NOTE 3 IEC 62769-7, defines the argument ReceiveData of the Transfer Method as an array of Variant. The argument ReadData defined in this Table 13 is represented as entry of the Variant array in the order specified above.

4.6.1.6 SetAddress

Table 14 shows the arguments of the Method SetAddress.

NOTE Modifying the address of a device will have an impact on the communications of a distributed control system (DCS) if present.

Signature:

```
SetAddress(
    [in]   String           OPERATION,
    [in]   ByteString       Address,
    [in]   String           NewPDTag,
    [in]   UInt32           ServiceId,
    [out]  UInt32           DelayForNextCall,
    [out]  Int32            ServiceError);
```

Table 14 – Method SetAddress arguments

Argument	Description
OPERATION [a]	The argument value indicates the type of addressing operation. Allowed values are "SETASSIGNMENT", "CLEARASSIGNMENT". The argument values given with the arguments below may be ignored depending on the value of the OPERATION argument.
Address	The argument name shall match with the corresponding attribute name defined for the ConnectionPoint which is described by a corresponding EDD element specified in 4.5.1. The argument value holds the device's IPv4 or IPv6 address.
NewPDTag [b]	The argument value holds the new PD-Tag to set for the device. The argument value is ignored if the OPERATION argument value is "CLEARASSIGNMENT".
ServiceId	The service transaction code establishes the relation between the service request and the corresponding response.
~~DelayForNextCall~~	~~The value specifies a delay time in ms to limit the EndTransfer invocation cycle that shall not be faster than specified in the argument value.~~

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Argument	Description
ServiceError	~~0: OK / function started asynchronously, result has to be polled with EndSetAddress~~ ~~1: OK / execution finished successfully~~ 0: OK/execution finished successfully −1: SetAddress Failed/canceled by caller −2: Call Failed/unknown service ID −3: SetAddress Failed/not initialized −4: SetAddress Failed/not connected to a network −5: SetAddress Failed/no device found responding to oldAddress −6: SetAddress Failed/duplicate address error −7: SetAddress Failed/device did not accept new address −8: SetAddress Failed/invalid oldAddress (in terms of syntax, data type, data format, and so on) −9: SetAddress Failed/invalid newAddress (in terms of syntax, data type, data format, and so on) −10: SetAddress Failed/not possible in status connected
[a] The arguments OPERATION defined with the table are represented as entries of the Variant array in the order they are specified above. [b] The arguments NewPDTag defined with the table are represented as entries of the Variant array in the order they are specified above.	

4.6.1.7 Scan

The Method signature specified in IEC 62769-7 applies. The corresponding topologyScanResult schema is specified in Annex A.

4.6.1.8 ResetScan

The Method signature specified in IEC 62769-7 applies.

4.6.2 Methods for Gateways

Not supported.

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Annex A
(normative)

Topology scan schema

A.1 General

The topology scan result schema specified in Annex A describes the CP 1/2 specific format Method Scan argument `topologyScanResult`. The XML document content and structure shall correspond to the Information Model designed concept to describe a topology in order to enable generic matching between physical devices connected to the network and the FDI Server hosted Information Model.

A.2 Network

The root element that is used to return the scan result of a CP 1/2 network.

The XML schema for a Network element is:

```
<xsd:element name="Network" type="ff:FoundationHSENetworkT"/>
```

A.3 FoundationHSEAddressT

A simple type that defines the address structure for CP 1/2. The address can be encoded as IPv4 or IPv6.

The XML schema for a FoundationHSEAddressT type is:

```
<xsd:simpleType name="FoundationHSEAddressT">
   <xsd:restriction base="xsd:string"/>
</xsd:simpleType>
```

A.4 FoundationHSEConnectionPointT

A complex type that defines the Connection Point for CP 1/2.

The XML schema for a FoundationHSEConnectionPointT type is:

```
<xsd:complexType name="FoundationHSEConnectionPointT">
   <xsd:sequence>
      <xsd:element name="Identification"
         type="ff:FoundationIdentificationT"/>
      <xsd:element name="BlockScanInstance"
         type="ff:FoundationBlockIdentificationT" minOccurs="0"
         maxOccurs="unbounded"/>
   </xsd:sequence>
   <xsd:attribute name="Address" type="ff:FoundationHSEAddressT"
      use="required"/>
   <xsd:attribute name="OrdinalNumber" type="xsd:unsignedInt"
      use="required"/>
</xsd:complexType>
```

The attributes of a FoundationHSEConnectionPointT type are described in Table A.1.

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Table A.1 – Attributes of FoundationHSEConnectionPointT

Attribute	Description
Address	The Attribute value holds the address of the network connected device.
OrdinalNumber	The OrdinalNumber property reflects the position of the VFD within the System Management VFD list. Multiple VFDs are mapped to multiple ScanItem elements.

The elements of a FoundationHSEConnectionPointT type are described in Table A.2.

Table A.2 – Elements of FoundationHSEConnectionPointT

Element	Description
Identification	The element data holds the device type identification data. Compared to the Information Model (IEC 62769-5) the ConnectionPoint does not contain or refer to the device type identification data. But in order to support the FDI host system in finding the package that matches the connected device, this schema associates the device type identification with the ConnectionPoint.
BlockScanInstance	Block instance information of the scanned device VFD. Used to create Block instances within the FDI Server IM. See IEC 62769-5.

A.5 FoundationHSENetworkT

A complex type that defines the network for CP 1/2.

The XML schema for a FoundationHSENetworkT type is:

```
<xsd:complexType name="FoundationHSENetworkT">
   <xsd:sequence>
      <xsd:element name="ConnectionPoint"
         type="ff:FoundationHSEConnectionPointT"
         maxOccurs="unbounded"/>
   </xsd:sequence>
</xsd:complexType>
```

The elements of a FoundationHSENetworkT type are described in Table A.3.

Table A.3 – Elements of FoundationHSENetworkT

Element	Description
ConnectionPoint	CP 1/2 Connection Point

A.6 FoundationBlockIdentificationT

A complex type that defines the block instance information of the scanned device.

The XML schema for a FoundationBlockIdentificationT type is:

```
<xsd:complexType name="FoundationBlockIdentificationT">
   <xsd:attribute name="BlockTag" use="required"/>
   <xsd:attribute name="DDItem" use="required"/>
   <xsd:attribute name="DirectoryPosition" use="required"/>
</xsd:complexType>
```

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