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REDLINE VERSION

INTERNATIONAL STANDARD



Field device integration (FDI)[®] –
Part 109-1: Profiles – HART[®] and WirelessHART[®]

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Part 109-1: Profiles – HART[®] and WirelessHART[®]

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CONTENTS

FOREWORD.....	4
1 Scope.....	6
2 Normative references	6
3 Terms, definitions, abbreviated terms and conventions acronyms.....	6
3.1 Terms and definitions.....	6
3.2 Abbreviated terms and acronyms	7
4 Conventions	7
4.1 EDDL syntax.....	7
4.2 XML syntax.....	7
4.3 Capitalizations	7
5 Profile for CP 9/1 (HART®) or CP 9/2 (WirelessHART®).....	8
5.1 General.....	8
5.2 Catalog profile	8
5.2.1 Protocol support file.....	8
5.2.2 CommunicationProfile definition.....	8
5.2.3 Profile device.....	9
5.2.4 Protocol version information	9
5.3 Associating a Package with a CP 9/1 device.....	10
5.3.1 Device type identification mapping.....	10
5.3.2 Device type revision mapping.....	10
5.4 Information Model mapping.....	10
5.4.1 ProtocolType definition	10
5.4.2 DeviceType mapping	10
5.4.3 FunctionalGroup Identification definition	11
5.5 Topology elements.....	11
5.5.1 ConnectionPoint definition	11
5.5.2 Communication Device definition	17
5.5.3 Communication service provider definition	18
5.5.4 Network definition.....	19
5.6 Methods.....	20
5.6.1 Methods for FDI® Communication Servers	20
5.6.2 Methods for Gateways	24
Annex A (normative) Topology scan schema.....	33
A.1 General.....	33
A.2 IdentificationType	33
A.3 AddressTypeTP	36
A.4 AddressTypeIP	37
A.5 AddressTypeTDMA.....	37
A.6 AddressType.....	38
A.7 ConnectionPointType.....	39
A.8 NetworkType.....	39
A.9 Network	40
Annex B (normative) Transfer service parameters.....	41
B.1 General.....	41
B.2 receiveData	41
B.3 sendData	41

- B.4 TransferResultDataT.....41
- B.5 TransferSendDataT.....42
- Annex C (informative) Mapping to PA DIM43
- C.1 General.....43
- C.2 Mapping Table43
- Bibliography.....44

- Table 1 – Device Information Files8
- Table 2 – CommunicationProfile definition9
- Table 3 – Catalog values for profile devices.....9
- Table 4 – Protocol Version Information9
- Table 5 – Device type catalog mapping.....10
- Table 6 – ProtocolType HART definition10
- Table 7 – Inherited DeviceType Property mapping11
- Table 8 – Identification parameters11
- Table 9 – ConnectionPointType HART_TP definition.....12
- Table 10 – ConnectionPointType HART_IP Definition14
- Table 11 – ConnectionPointType HART_TDMA Definition.....17
- Table 12 – Method Connect arguments.....21
- Table 13 – Method Disconnect arguments21
- Table 14 – Method Transfer arguments.....22
- Table 15 – Method GetPublishedData arguments.....23
- Table 16 – Method SetAddress arguments.....24
- Table 17 – Method Connect arguments.....25
- Table 18 – Method Disconnect arguments26
- Table 19 – Method Transfer arguments.....27
- Table 20 – Method GetPublishedData arguments.....29
- Table 21 – Method SetAddress arguments.....30
- Table A.1 – Attributes of IdentificationT35
- Table A.2 – Elements of AddressTypeTP36
- Table A.3 – Elements of AddressTypeIP37
- Table A.4 – Elements of AddressTypeTDMA.....38
- Table A.5 – Elements of AddressT38
- Table A.6 – Elements of ConnectionPointT39
- Table A.7 – Elements of NetworkT39
- Table B.1 – Attributes of TransferResultDataT41
- Table B.2 – Attributes of TransferSendDataT42
- Table C.1 – Mapping from HART standard parameters to PA DIM.....43

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Part 109-1: Profiles – HART® and WirelessHART®

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IEC 62769-109-1 has been prepared by subcommittee 65E: Devices and integration in enterprise systems, of IEC technical committee 65: Industrial-process measurement, control and automation. It is an International Standard.

This third edition cancels and replaces the second edition published in 2020. This edition constitutes a technical revision.

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

- a) added content type for DeviceInfo files;
- b) added mapping from HART standard parameters to PA DIM;

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

Draft	Report on voting
65E/864/CDV	65E/921/RVC

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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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FIELD DEVICE INTEGRATION (FDI®) –

Part 109-1: Profiles – HART® and WirelessHART®

1 Scope

This part of IEC 62769 specifies an FDI^{®1} profile of IEC 62769 for IEC 61784-1_CP 9/1 (HART^{®2}) and IEC 61784-1_CP 9/2 (WirelessHART^{®3}).

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 62541-100:~~2015~~, *OPC Unified Architecture Specification – Part 100: OPC Device Interface*

IEC 62769-4:~~4~~, *Field device integration (FDI[®]) – Part 4: FDI[®] Packages*

IEC 62769-5, *Field device integration (FDI[®]) – Part 5: ~~FDI~~ Information Model*

IEC 62769-7, *Field device integration (FDI[®]) – Part 7: ~~FDI~~ Communication devices*

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

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62541-100, IEC 62769-4, IEC 62769-5 and IEC 62769-7 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>

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⁴ ~~Under preparation. Stage at the time of publication: IEC/RFDIS-62769-4:2020.~~

3.2 Abbreviated terms and acronyms

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

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 the IEC 61804 series)
EDDL	Electronic device description language (see the IEC 61804 series)
FDI [®]	Field device integration
FSK	Frequency-Shift-Keying
HCF	HART Communication Foundation
ID	Identification
IM	Information Model
IP	Internet protocol
PDU	Protocol data unit
PSK	Phase-Shift-Keying
TCP	Transmission Control Protocol (see IETF RFC 793)
UDP	User Datagram Protocol (see IETF RFC 768)
XML	Extensible Extended markup language

4 Conventions

4.1 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.

4.2 XML syntax

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

Example: `<xs:simpleType name="ExampleT">`

4.3 Capitalizations

The IEC 62769 series uses capitalized terms to emphasize that these terms have an FDI[®] specific meaning.

Some of these terms using an acronym as a prefix, for example

- FDI[®] Client or
- FDI[®] Server.

Some of these terms are compound terms such as:

- FDI[®] Communication Servers or
- Profile Package.

Parameter names or attributes are concatenated to a single term, where the original terms start in this term with a capital letter such as:

- ProtocolSupportFile or

- ProtocolType.

Parameter names or attributes can also be constructed by using an underscore character to concatenate two or more terms like:

- PROFILE_ID or
- HART_Network

5 Profile for CP 9/1 (HART®) or CP 9/2 (WirelessHART®)

5.1 General

This profile document to the FDI® specification in IEC 62769 selects the protocol specifics needed for FDI® Packages describing FDI® Communication Servers, gateways and devices.

Annex B defines the XML schema for Direct Access Services. Annex C provides an overview of mapping PROFIBUS standard parameters to PA DIM.

5.2 Catalog profile

5.2.1 Protocol support file

Device information files provide metadata for the dynamic runtime data that is supplied by the device. This metadata is a subset of information that is contained in the EDD. The device information files may be extracted from the package by light-weight gateway or server implementations to exchange runtime device information with minimal implementation overhead. Device information files do not replace the need for the EDD part because device information files only contain a subset of the information from the EDD, and do not provide any user-interface elements.

The formats of the Device Information Files are described in Table 1.

Table 1 – Device Information Files

Part	Content
Content Type	Not specified here application/vnd.hart.json
Root Namespace	Not specified here
Source Relationship	http:// fdi-cooperation.com/2010/relationships/attachment-protocol
Filename	Not specified here

The Device Information Files are specified in FCG AG21073.

5.2.2 CommunicationProfile definition

IEC 62769-4 defines a CommunicationProfileT string type for the Catalog XML schema. Table 2 defines the CP 9/1 specific values for this enumeration.

Table 2 – CommunicationProfile definition

CommunicationProfile	Description
hart_fsk	CP 9/1 device type that supports an FSK physical layer (Frequency-Shift-Keying on a pair of wires)
hart_psk	CP 9/1 device type that supports a PSK physical layer (Phase-Shift-Keying on a pair of wires). Devices supporting PSK are required to also inherently support FSK, and therefore PSK will always be used only in combination with at least FSK.
hart_wirelesshart	CP 9/2 device type that supports a wireless physical layer (communication between device and gateway).
hart_ip	CP 9/1 device type that supports Internet Protocol (these devices support both TCP and UDP).
hart_rs485	CP 9/1 device type that supports EIA-485 digital communication.
hart_ir	CP 9/1 device type that supports an Infrared physical layer (designed to be transparent to FSK masters – included only as information to indicate that the device supports IR connection).
NOTE It is possible for a single CP 9/1 device to support more than one CP.	

5.2.3 Profile device

A Profile Package shall provide the catalog values for profile devices, enabling the FDI® Server to leverage a generic device description, if a specific one is not available. The definitions in Table 3 focus on catalog content that is vendor independent.

Table 3 – Catalog values for profile devices

Element	Attribute	Content
PackageType	—	Profile
DeviceModel	—	Empty
Manufacturer	—	Empty

5.2.4 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 has to follow the IEC 62769-4 defined version information schema defined in element type VersionT. Subclause 5.2.4 describes how to apply the currently known protocol versions for CP 9/1 or CP 9/2 entries in the device catalog. The general rule is to use the Universal Revision of the protocol for the major version part of VersionT, and the value “0” for the minor version and build parts. Table 4 shows the Protocol Version Information.

Table 4 – Protocol Version Information

Protocol Version	InterfaceT Version value
HART Universal Revision 5	5.0.0
HART Universal Revision 6	6.0.0
HART Universal Revision 7	7.0.0
The Protocol Version defined in a package is provided for informational purposes only, and shall not be used to determine the compatibility or applicability of a package to a device.	

5.3 Associating a Package with a CP 9/1 device

5.3.1 Device type identification mapping

CP 9/1 device types are uniquely identified by parameters Manufacturer, Model and DeviceRevision. 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 5.

Table 5 – Device type catalog mapping

Catalog element	CP mapping (See Table A.1)
Manufacturer element of InterfaceT (IEC 62769-4:2023, Clause E.11)	Manufacturer String format "0xddd" where dddd is the MANUFACTURER_ID in hexadecimal format.
DeviceModel element of InterfaceT (IEC 62769-4:2023, Clause E.11)	Model String format "0xddd" where dddd is the DEVICE_TYPE in hexadecimal format.
DeviceRevision element ListOfSupportedDeviceRevisionsT (IEC 62769-4:2023, Clause E.20)	DeviceRevision String format "x.0.0" where x is the DEVICE_REVISION in decimal format (no leading zeros).

5.3.2 Device type revision mapping

Each device type is identified as per 5.3.1. If a package with matching DeviceRevision is not available, any CP 9/1 FDI® package for a corresponding manufacturer and model shall always be compatible with a field device as long as the device revision of the field device is equal to or greater than the device revision specified in the FDI® package.

5.4 Information Model mapping

5.4.1 ProtocolType definition

Table 6 defines the ProtocolType used to identify CP 9/1 network communications.

Table 6 – ProtocolType HART definition

Attribute	Value				
BrowseName	HART				
IsAbstract	False				
References	NodeClass	BrowseName	Data Type	TypeDefinition	ModellingRule
Inherits the properties of ProtocolType defined in IEC 62541-100					

5.4.2 DeviceType mapping

Each device type inherits the properties of DeviceType. The mapping of the inherited properties from DeviceType is defined in Table 7.

Table 7 – Inherited DeviceType Property mapping

Property	Foundation mapping
SerialNumber	Unique ID of a device, mapped to SERIAL_NUMBER of IdentificationT.
RevisionCounter	Configuration change counter, mapped to REV_COUNTER of IdentificationT
Manufacturer	String taken from FDI [®] package catalog (ManufacturerName from PackageT)
Model	String taken from FDI [®] package catalog (Name of DeviceTypeT, which is a localized name)
DeviceManual	Entry text string (not supported) ^a
DeviceRevision	Device revision level of a device, mapped to DEVICE_REVISION of IdentificationT
SoftwareRevision	Software revision level of a device, mapped to SOFTWARE_REVISION of IdentificationT
HardwareRevision	Hardware revision level of a device, mapped to HARDWARE_REVISION of IdentificationT
^a Device manuals are exposed as attachments of the FDI [®] Device Package.	

5.4.3 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 device type instance. The FunctionalGroup Identification for CP 9/1 is defined in Table 8.

Table 8 – Identification parameters

BrowseName	Data Type	Optional/Mandatory
MANUFACTURER_ID	UInt16	Mandatory
DEVICE_TYPE	UInt16	Mandatory
DEVICE_REVISION	UInt8	Mandatory
UNIVERSAL_REVISION	UInt8	Optional
SERIAL_NUMBER	UInt24	Optional
HARDWARE_REVISION	UInt8	Optional
SOFTWARE_REVISION	UInt8	Optional
REVISION_COUNTER	UInt16	Optional

5.5 Topology elements

5.5.1 ConnectionPoint definition

5.5.1.1 General

CP 9/1 devices can support up to five different ConnectionPoint types that are used for network communications.

5.5.1.2 HART_TP5, HART_TP6, HART_TP7

The ConnectionPoint types HART_TP5, HART_TP6, and HART_TP7 shall be used to identify CP 9/1 token passing network communication and are defined in Table 9. HART_TP5, HART_TP6, and HART_TP7 all contain the same properties, but each provides different

qualification information for some of the properties (described below). The Protocol Version (UNIVERSAL_REVISION) described in 5.2.3 can be used as an aid to determine which of the three token passing Connection Point types is the most appropriate. CP 9/1 token passing communications can be used on a variety of physical layers. FSK, PSK, RS485, and Infrared physical layer connections shall all use the HART_TP connection type. The ConnectionPoint types HART_TP5, HART_TP6, and HART_TP7 are subtypes of abstract type ConnectionPointType defined in IEC 62769-5.

The DevAddr property shall be the long address (5 bytes) for the device, and is the only parameter necessary to communicate with the field device.

The DevMfg property shall be the 2-byte Manufacturer ID, and can be used to help automate the process of assigning live devices in the scan list to offline placeholders.

The DevType property shall be the 2-byte extended device type, and can be used to help automate the process of assigning live devices in the scan list to offline placeholders.

The DevRev property shall be the device revision, and can be used to help automate the process of assigning live devices in the scan list to offline placeholders.

The DevTag property shall be the long tag for HART® protocol version 6 or 7 devices. The DevTag property shall be the tag for protocol version 5 devices. The DevTag property can be used to help automate the process of assigning live devices in the scan list to offline placeholders. HART_TP5 Connection Points shall limit the DevTag to 8 characters in length. HART_TP6 and HART_TP7 Connection Points shall limit the DevTag to 32 characters in length.

The DevPollAddr property shall be the poll address, and can be used to identify which device is located at a specific poll address. HART_TP5 Connection Points shall be limited to values between 0 and 15 for the DevPollAddr property. HART_TP6 Connection Points shall be limited to values between 0 and 31 for the DevPollAddr property. HART_TP7 Connection Points shall be limited to values between 0 and 63 for the DevPollAddr property.

For forward compatibility, a lower revision HART_TP Connection Point is compatible and can be used for a higher universal revision device connection. For example, if a future HART universal revision 8 device is encountered, and no HART_TP8 is available in the FDI® server, HART_TP7 will be compatible and shall be used to connect to the device. If the Protocol Version (i.e. the Universal Revision) is unknown for any reason, the HART_TP5 Connection Point can be used, and will be forward compatible to later universal revisions.

Table 9 – ConnectionPointType HART_TP definition

Attribute	Value				
BrowseName	ConnectionPoint_HART_TP5 or ConnectionPoint_HART_TP6 or ConnectionPoint_HART_TP7				
IsAbstract	False				
References	NodeClass	BrowseName	Data Type	TypeDefinition	ModellingRule
Inherits the properties of ConnectionPointType defined in IEC 62769-5					
HasProperty	Variable	DevAddr	UInt40	PropertyType	Mandatory
HasProperty	Variable	DevMfg	UInt16	PropertyType	Optional
HasProperty	Variable	DevType	UInt16	PropertyType	Optional
HasProperty	Variable	DevRev	UInt16	PropertyType	Optional
HasProperty	Variable	DevTag	String	PropertyType	Optional
HasProperty	Variable	DevPollAddr	UInt8	PropertyType	Optional

The ConnectionPoint type HART_TP5, HART_TP6, and HART_TP7 shall be described by an EDD element contained in a Communication Device related FDI® Package that can drive a CP 9/1 network. Actual ConnectionPoint properties are declared by VARIABLE constructs grouped together in a COLLECTION named ConnectionPoint_HART_TP5, ConnectionPoint_HART_TP6, or ConnectionPoint_HART_TP7. The following EDDL source code is an example describing a TP5 Connection Point.

```
COMPONENT ConnectionPoint_HART_TP5
{
  LABEL "HART TP Connection Point";
  CLASSIFICATION NETWORK_CONNECTION_POINT;
  CAN_DELETE FALSE;
  PROTOCOL HART;
  CONNECTION_POINT ConnectionPoint_TP5;
}

VARIABLE DevAddr
{
  LABEL "Address";
  CLASS DEVICE;
  TYPE UNSIGNED_INTEGER(5);
  HANDLING READ & WRITE;
}

VARIABLE DevMfg
{
  LABEL "Manufacturer";
  CLASS DEVICE;
  TYPE UNSIGNED_INTEGER(2);
  HANDLING READ & WRITE;
}

VARIABLE DevType
{
  LABEL "Device Type";
  CLASS DEVICE;
  TYPE UNSIGNED_INTEGER(2);
  HANDLING READ & WRITE;
}

VARIABLE DevRev
{
  LABEL "Device Revision";
  CLASS DEVICE;
  TYPE UNSIGNED_INTEGER;
  HANDLING READ & WRITE;
}

VARIABLE DevTag
{
  LABEL "Tag";
  CLASS DEVICE;
  TYPE ASCII(32);
  HANDLING READ & WRITE;
}
```

```
VARIABLE DevPollAddr
{
    LABEL "Poll Address";
    CLASS DEVICE;
    TYPE UNSIGNED_INTEGER
    {
        MAX_VALUE 15; //Define appropriate max value for various revisions
    }
    HANDLING READ & WRITE;
}

COLLECTION ConnectionPoint_TP5
{
    LABEL "Connection Point";
    MEMBERS
    {
        ADDRESS,    DevAddr,    "Device Address";
        MFG,        DevMfg,    "Manufacturer";
        DEV_TYPE,   DevType,    "Device Type";
        DEV_REV,    DevRev,    "Device Revision";
        TAG,        DevTag,    "Device Tag";
        POLL_ADDR, DevPollAddr, "Poll Address";
    }
}
```

5.5.1.3 HART_IP

The ConnectionPoint type HART_IP shall be used to identify CP 9/1 IP network communication and is defined in Table 10. HART_IP communications can be used on a variety of physical layers. Ethernet connections shall all use the HART_IP connection type. Additional physical layers developed in the future may also use the HART_IP connection type. The ConnectionPoint type HART_IP is a subtype of abstract type ConnectionPointType defined in IEC 62769-5.

The IPAddress property shall indicate the IP Address (up to 16 bytes) used for the connection.

The IPVersion property shall indicate the version of IP used for the connection (either 4 or 6).

The IPPort property shall be the IP port number for the connection. The default port number used for HART IP is 5094.

The DevAddr property shall be the long address (5 bytes) for the device.

The DevMfg property shall be the 2-byte Manufacturer ID, and can be used to help automate the process of assigning live devices in the scan list to offline placeholders.

The DevType property shall be the 2-byte extended device type, and can be used to help automate the process of assigning live devices in the scan list to offline placeholders.

The DevRev property shall be the device revision, and can be used to help automate the process of assigning live devices in the scan list to offline placeholders.

The DevTag property shall be the long tag (with maximum 32 characters), and can be used to help automate the process of assigning live devices in the scan list to offline placeholders.

Table 10 – ConnectionPointType HART_IP Definition

Attribute	Value				
BrowseName	ConnectionPoint_HART_IP				
IsAbstract	False				
References	NodeClass	BrowseName	Data Type	Type Definition	Modelling Rule
Inherits the properties of ConnectionPointType defined in IEC 62769-5					
HasProperty	Variable	IPAddress	ByteString	PropertyType	Mandatory
HasProperty	Variable	IPVersion	UInt8	PropertyType	Mandatory
HasProperty	Variable	IPPort	UInt16	PropertyType	Mandatory
HasProperty	Variable	DevAddr	UInt40	PropertyType	Mandatory
HasProperty	Variable	DevMfg	UInt16	PropertyType	Optional
HasProperty	Variable	DevType	UInt16	PropertyType	Optional
HasProperty	Variable	DevRev	UInt16	PropertyType	Optional
HasProperty	Variable	DevTag	String	PropertyType	Optional

The ConnectionPoint type HART_IP shall be described by an EDD element contained in a Communication Device related FDI® Package that can drive a CP 9/1 network. Actual ConnectionPoint properties are declared by VARIABLE constructs grouped together in a COLLECTION named ConnectionPoint_HART_IP. The following EDDL source code is an example describing an IP Connection Point.

```

COMPONENT ConnectionPoint_HART_IP
{
  LABEL "HART IP Connection Point";
  CLASSIFICATION NETWORK_CONNECTION_POINT;
  CAN_DELETE FALSE;
  PROTOCOL HART;
  CONNECTION_POINT ConnectionPoint_IP;
}

ARRAY IPAddress
{
  LABEL "IP Address";
  CLASS DEVICE;
  TYPE OCTET (16);
  HANDLING READ & WRITE;
}

VARIABLE IPVersion
{
  LABEL "IP Version";
  CLASS DEVICE;
  TYPE ENUMERATED
  {
    { 4, "IPv4" },
    { 6, "IPv6" }
  }
  HANDLING READ & WRITE;
}

```

```

}

VARIABLE IPPort
{
    LABEL "IP Port";
    CLASS DEVICE;
    TYPE UNSIGNED_INTEGER (2);
    DEFAULT_VALUE 5-0945094;
    HANDLING READ & WRITE;
}

COLLECTION ConnectionPoint_IP
{
    LABEL "Connection Point";
    MEMBERS
    {
        IPADDRESS, IPAddress, "IP Address";
        IPVERSION, IPVersion, "IP Version";
        IPPORT, IPPort, "IP Port";
        ADDRESS, DevAddr, "Device Address";
        MFG, DevMfg, "Manufacturer";
        DEV_TYPE, DevType, "Device Type";
        DEV_REV, DevRev, "Device Revision";
        TAG, DevTag, "Device Tag";
    }
}

```

5.5.1.4 HART_TDMA

The ConnectionPoint type HART_TDMA shall be used to identify CP 9/2 time division media access network communication and is defined in Table 11. HART_TDMA communications can be used on a variety of physical layers. The ConnectionPoint type HART_TDMA is a subtype of abstract type ConnectionPointType defined in IEC 62769-5. WirelessHART connections shall all use the HART_TDMA connection type. Additional physical layers developed in the future may also use the HART_TDMA connection type.

The Network property shall be the network ID for the network.

The DevAddr property shall be the long address (5 bytes) for the device.

The DevMfg property shall be the 2 byte Manufacturer ID, and can be used to help automate the process of assigning live devices in the scan list to offline placeholders.

The DevType property shall be the 2 byte extended device type, and can be used to help automate the process of assigning live devices in the scan list to offline placeholders.

The DevRev property shall be the device revision, and can be used to help automate the process of assigning live devices in the scan list to offline placeholders.

The DevTag property shall be the long tag (with maximum 32 characters), and can be used to help automate the process of assigning live devices in the scan list to offline placeholders.

Table 11 – ConnectionPointType HART_TDMA Definition

Attribute	Value				
BrowseName	ConnectionPoint_HART_TDMA				
IsAbstract	False				
References	NodeClass	BrowseName	Data Type	Type Definition	Modelling Rule
Inherits the properties of ConnectionPointType defined in IEC 62769-5					
HasProperty	Variable	Network	UInt16	PropertyType	Mandatory
HasProperty	Variable	DevAddr	UInt40	PropertyType	Mandatory
HasProperty	Variable	DevMfg	UInt16	PropertyType	Optional
HasProperty	Variable	DevType	UInt16	PropertyType	Optional
HasProperty	Variable	DevRev	UInt16	PropertyType	Optional
HasProperty	Variable	DevTag	String	PropertyType	Optional

The ConnectionPoint type HART_TDMA shall be described by an EDD element contained in a Communication Device related FDI® Package that can drive a CP 9/2 network. Actual ConnectionPoint properties are declared by VARIABLE constructs grouped together in a COLLECTION named ConnectionPoint_HART_TDMA. The following EDDL source code is an example describing a TDMA Connection Point.

```

COMPONENT ConnectionPoint_HART_TDMA
{
  LABEL "HART TDMA Connection Point";
  CLASSIFICATION NETWORK_CONNECTION_POINT;
  CAN_DELETE FALSE;
  PROTOCOL HART;
  CONNECTION_POINT ConnectionPoint_TDMA;
}

VARIABLE Network
{
  LABEL "Network ID";
  CLASS DEVICE;
  TYPE UNSIGNED_INTEGER (2);
  HANDLING READ & WRITE;
}

COLLECTION ConnectionPoint_TDMA
{
  LABEL "Connection Point";
  MEMBERS
  {
    NETWORK, Network, "Network ID";
    ADDRESS, DevAddr, "Device Address";
    MFG, DevMfg, "Manufacturer";
    DEV_TYPE, DevType, "Device Type";
    DEV_REV, DevRev, "Device Revision";
    TAG, DevTag, "Device Tag";
  }
}

```

5.5.2 Communication Device definition

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

```

COMPONENT CommunicationServer_HART
{
  LABEL "HART Communication Server";
  CAN_DELETE TRUE;
  CLASSIFICATION NETWORK_COMPONENT;
  COMPONENT_RELATIONS { Communication_Device_Setup_HART}
}

```

```

COMPONENT_RELATION Communication_Device_Setup_HART
{
  LABEL "Relation between Device and Communication Device";
  RELATION_TYPE CHILD_COMPONENT;
  COMPONENTS
  {
    CommunicationDevice_HART{AUTO_CREATE 1;}
  }
  MINIMUM_NUMBER 1;
  MAXIMUM_NUMBER 4;
}

```

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 communication device component. The following EDDL source code is an example for a CP 9/1 communication device.

```

COMPONENT CommunicationDevice_HART
{
  LABEL "HART Communication Device";
  CAN_DELETE TRUE;
  CLASSIFICATION NETWORK_COMPONENT;
  COMPONENT_RELATIONS { ServiceProviderRelation_HART}
  BYTE_ORDER BIG_ENDIAN;
}

COMPONENT_RELATION ServiceProviderRelation_HART
{
  LABEL "Relation to communication service provider";
  RELATION_TYPE CHILD_COMPONENT;
  COMPONENTS
  {
    CommunicationServiceProvider_HART {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 CommunicationServerChannelType as described in IEC 62769-7.

5.5.3 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 9/1 communication service provider component.

The component reference (ConnectionPoint_HART_IP) corresponds to one of the related Connection Point definitions in 5.5.1. The attribute BYTE_ORDER value is to be set according to the protocol.

```

COMPONENT CommunicationServiceProvider_HART
{
  LABEL "HART Communication Service Provider";
  CAN_DELETE FALSE;
  CLASSIFICATION NETWORK_COMMUNICATION_SERVICE_PROVIDER;
  COMPONENT_RELATIONS { ServiceProviderConnectionPointRelation_HART }
  BYTE_ORDER BIG_ENDIAN;
}

COMPONENT_RELATION ServiceProviderConnectionPointRelation_HART
{
  LABEL "Relation between communication service and connection point";
  RELATION_TYPE CHILD_COMPONENT;
  ADDRESSING
  {
    IPAddress
  }
  COMPONENTS
  {
    ConnectionPoint_HART_IP { 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 CommunicationServiceType as described in IEC 62769-7.

5.5.4 Network definition

According to IEC 62769-7 each FDI[®] Communication Package shall contain at least one EDD element describing network configuration constraints using the component construct. The following EDDL source code is an example describing a network.

```

COMPONENT Network_HART
{
  LABEL "HART Network";
  CAN_DELETE TRUE;
  CLASSIFICATION NETWORK;
  COMPONENT_RELATIONS { NetworkConnectionPointRelation_HART }
}

```

```

COMPONENT_RELATION NetworkConnectionPointRelation_HART
{
  LABEL "Relation between network and connection point";
  RELATION_TYPE CHILD_COMPONENT;
  ADDRESSING {DevPollAddr}
  COMPONENTS
  {
    ConnectionPoint_HART_TP5
    {
      MAXIMUM_NUMBER 16;
    },
    ConnectionPoint_HART_TP6
    {
      MAXIMUM_NUMBER 32;
    },
    ConnectionPoint_HART_TP7
    {
      MAXIMUM_NUMBER 64;
    }
  }
  MINIMUM_NUMBER 1;
  MAXIMUM_NUMBER 64; //Defined to limitations of the comm. device
}

```

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 in IEC 62769-5. Some communication devices may organize multiple IO cards as individual networks, while others may present a single network that comprises all Connection Points across all IO cards.

5.6 Methods

5.6.1 Methods for FDI[®] Communication Servers

5.6.1.1 General

The FDI[®] Communication Server shall implement services according to the method signatures described in this section and according to the FDI[®] Information Model.

5.6.1.2 Connect

Table 12 shows the Method Connect arguments.

Signature:

```

Connect (
  [in]  ByteString CommunicationRelationId,
  [in]  ByteString LongAddress,
  [out] Int32      ServiceError);

```

Table 12 – 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 which is directly connected to the FDI [®] Communication Server hardware. The nodeId allows finding the direct parent-child relation.
LongAddress	The argument name shall match with the corresponding attribute name defined for the ConnectionPoint which is described by a corresponding EDD element specified in 5.5.1. The argument holds the device's long (5-byte) address. The value can be obtained by the method Scan.
ServiceError	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
<p>NOTE 1 IEC 62769-7, defines the argument AddressData of the Connect Method as an array of Variant. The LongAddress arguments defined in the table are represented as entries of the Variant array in the order they are specified above.</p> <p>NOTE 2 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 for CP 9/1 devices.</p>	

5.6.1.3 Disconnect

Table 13 shows the Method Disconnect arguments.

Signature:

```

Disconnect (
    [in]  ByteString CommunicationRelationId,
    [out] Int32      ServiceError);

```

Table 13 – Method Disconnect arguments

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

5.6.1.4 Transfer

Table 14 shows the Method Transfer arguments.

Signature

```

Transfer (
    [in]  ByteString CommunicationRelationId,
    [in]  UInt16      Command,
    [in]  ByteString Request,
    [out] ByteString Reply,
    [out] Int32      ServiceError);
    
```

Table 14 – 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 which is directly connected to the FDI® Communication Server hardware. The nodeId allows finding the direct parent-child relation.
Command	Command number of the CP 9/1 command to be sent. The FDI® Communication Server is required to generate and send the PDU in the proper format according to CP 9/1 protocol specifications (e.g. taking care of command expansion).
Request	An array of bytes representing the data bytes in the CP 9/1 command request (e.g. starting after the byte count, and ending before the checksum).
Reply	An array of bytes representing the data bytes in the CP 9/1 command response (e.g. starting after the byte count, and ending before the checksum).
ServiceError	0: OK / execution finished -1: Transfer Failed / cancelled 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 Request content -6: Transfer Failed / invalid Reply format
NOTE 1 IEC 62769-7 defines the argument SendData of the Transfer Method as an array of Variant. The arguments Command and Request defined in the table 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 Reply defined in the table is represented as the entry of the Variant array.	

5.6.1.5 GetPublishedData

CP 9/1 burst and event notification messages represent unsolicited messages as defined in IEC 62769-7. Table 15 shows the Method GetPublishedData arguments.

Signature:

```

GetPublishedData (
    [in]  ByteString CommunicationRelationId,
    [out] UInt16      Command,
    [out] ByteString Reply,
    [out] DateTime    TimeStamp,
    [out] Int32      ServiceError);
    
```

Table 15 – 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.
Command	Command number of the CP 9/1 command published. The FDI [®] Communication Server is required to parse the PDU in various formats according to CP 9/1 Protocol standards (e.g. taking care of command expansion).
Reply	An array of bytes representing the data bytes in the published CP 9/1 command response (e.g. starting after the byte count, and ending before the checksum).
TimeStamp	Time at which the published data was captured.
ServiceError	0: OK / execution finished -1: GetPublishedData Failed / cancelled 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 burst / event data published.
NOTE IEC 62769-7 defines the argument ReceiveData of the GetPublishedData Method as an array of Variant. The arguments Command and Reply defined in the table are represented as entries of the Variant array in the order they are specified above.	

5.6.1.6 SetAddress

Table 16 shows the Method SetAddress arguments.

Signature

```
SetAddress (
    [in] UInt8 OldPollAddress,
    [in] UInt8 NewPollAddress,
    [out] Int32 ServiceError);
```

Table 16 – Method SetAddress arguments

Argument	Description
OldPollAddress	The argument value holds the current address of a device. Allowed values are 0..63.
NewPollAddress	The argument value holds the new address for a device. Allowed values are 0..63
ServiceError	0: OK / execution finished successfully -1: SetAddress Failed / cancelled 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
NOTE 1 IEC 62769-7 defines the argument OldAddress of the SetAddress Method as an array of Variant. The argument OldPollAddress defined in the table is represented as the entry of the Variant array.	
NOTE 2 IEC 62769-7 defines the argument NewAddress of the SetAddress Method as an array of Variant. The argument NewPollAddress defined in the table is represented as the entry of the Variant array.	

5.6.1.7 Scan

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

5.6.1.8 ResetScan

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

5.6.2 Methods for Gateways

5.6.2.1 General

The method signatures described in 5.6.2 shall be implemented in the EDD element IEC 62769-4 contained in a Gateway related FDI[®] Package containing the communication device definitions.

5.6.2.2 Connect

Table 17 shows the Method Connect arguments.

Signature:

```

METHOD BeginConnect (
    DD_String      CommunicationRelationId,
    DD_String      LongAddress,
    unsigned long  ServiceID,
    unsigned long  &DelayForNextCall,
    long           &ServiceError)
{
    DEFINITION {<Gateway specific implementation>}
}

METHOD EndConnect (
    DD_String      CommunicationRelationId,
    unsigned long  ServiceID,
    unsigned long  &DelayForNextCall,
    long           &ServiceError);
{
    DEFINITION {<Gateway specific implementation>}
}

METHOD CancelConnect (
    DD_String      CommunicationRelationId,
    unsigned long  ServiceID,
    long           &ServiceError);
{
    DEFINITION {<Gateway specific implementation>}
}

```

Table 17 – Method Connect arguments

Argument	Description
CommunicationRelationId	The argument value contains the nodeId of the ConnectionPoint representing the connection between a device and a physical network which is directly connected to the FDI [®] Communication Server hardware. The nodeId allows finding the direct parent-child relation.
LongAddress	The argument name shall match with the corresponding attribute name defined for the ConnectionPoint which is described by a corresponding EDD element specified in 5.5.1. The argument holds the devices long (5-byte) address. The value can be obtained by the method Scan.
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.
ServiceError	1: OK / function started asynchronously, result has to be polled with EndConnect 0: OK / execution finished, connection established successfully -1: Connect Failed / cancelled by caller -2: Call Failed / unknown service ID -3: Connect Failed / device not found -4: Connect Failed / invalid device address -5: Connect Failed / invalid device identification

5.6.2.3 Disconnect

Table 18 shows the Method Disconnect arguments.

Signature:

```

METHOD Disconnect (
    DD_String communicationRelationId,
    Long &serviceError)
{
    DEFINITION {<Gateway specific implementation>}
}
    
```

Table 18 – Method Disconnect arguments

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

5.6.2.4 Transfer

Table 19 shows the Method Transfer arguments.

Signature:

```

METHOD BeginTransfer (
    DD_String CommunicationRelationId,
    unsigned short Command,
    DD_String Request,
    DD_String &Reply,
    unsigned long ServiceId,
    unsigned long &DelayForNextCall,
    long &ServiceError);
{
    DEFINITION {<Gateway specific implementation>}
}
    
```

```

METHOD EndTransfer (
    DD_String CommunicationRelationId,
    DD_String &Reply,
    unsigned long ServiceId,
    unsigned long &DelayForNextCall,
    long &ServiceError);
{
    DEFINITION {<Gateway specific implementation>}
}
    
```

```

METHOD CancelTransfer (
    DD_String CommunicationRelationId,
    unsigned long ServiceId,
    long &ServiceError);
{
    DEFINITION {<Gateway specific implementation>}
}
    
```

Table 19 – 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 which is directly connected to the FDI [®] Communication Server hardware. The nodeId allows finding the direct parent-child relation.
Command	Command number of the CP 9/1 command to be sent. The FDI [®] Communication Server is required to generate and send the PDU in the proper format according to CP 9/1 protocol specifications (e.g. taking care of command expansion).
Request	An array of bytes representing the data bytes in the CP 9/1 command request (e.g. starting after the byte count, and ending before the checksum).
Reply	An array of bytes representing the data bytes in the CP 9/1 command response (e.g. starting after the byte count, and ending before the checksum).
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.
ServiceError	<ul style="list-style-type: none"> 1: OK / function started asynchronously, result has to be polled with EndTransfer 0: OK / execution finished -1: Transfer Failed / cancelled 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 REQUEST content -6: Transfer Failed / invalid REPLY format

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5.6.2.5 GetPublishedData

CP 9/1 burst and event notification messages represent unsolicited messages as defined with IEC 62769-7. Table 20 shows the Method GetPublishedData arguments.

Signature

```
METHOD BeginGetPublishedData (  
    DD_String      CommunicationRelationId,  
    unsigned short &Command,  
    DD_String      &Reply,  
    TIME           &TimeStamp  
    unsigned long  ServiceId,  
    unsigned long  &DelayForNextCall,  
    long           &ServiceError);  
{  
    DEFINITION {<Gateway specific implementation>}  
}
```

```
METHOD EndGetPublishedData (  
    DD_String      CommunicationRelationId,  
    unsigned short &Command,  
    DD_STRING      &Reply,  
    TIME           &TimeStamp  
    unsigned long  ServiceId,  
    unsigned long  &DelayForNextCall,  
    long           &ServiceError);  
{  
    DEFINITION {<Gateway specific implementation>}  
}
```

```
METHOD CancelGetPublishedData (  
    DD_String      CommunicationRelationId,  
    unsigned long  ServiceId,  
    long           &ServiceError);  
{  
    DEFINITION {<Gateway specific implementation>}  
}
```

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Table 20 – 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.
Command	Command number of the CP 9/1 command published. The FDI [®] Communication Server is required to parse the PDU in various formats according to CP 9/1 Protocol standards (e.g. taking care of command expansion).
Reply	An array of bytes representing the data bytes in the published CP 9/1 command response (e.g. starting after the byte count, and ending before the checksum).
TimeStamp	Time at which the published data was captured.
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	1: OK / function started asynchronously, result has to be polled with EndGetPublishedData 0: OK / execution finished -1: GetPublishedData Failed / cancelled 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 burst information published

5.6.2.6 SetAddress

Table 21 shows the Method SetAddress arguments.

Signature

```

METHOD BeginSetAddress (
    unsigned char OldPollAddress,
    unsigned char NewPollAddress,
    unsigned long ServiceId,
    unsigned long &DelayForNextCall,
    long &ServiceError);
{
    DEFINITION {<Gateway specific implementation>}
}

METHOD EndSetAddress (
    unsigned long ServiceId,
    unsigned long &DelayForNextCall,
    long &ServiceError);
{
    DEFINITION {<Gateway specific implementation>}
}

METHOD BeginSetAddress (
    unsigned long ServiceId,
    long &ServiceError);
{
    DEFINITION {<Gateway specific implementation>}
}

```

Table 21 – Method SetAddress arguments

Argument	Description
OldPollAddress	The argument value holds the current address of a device. The allowed values are 0..63.
NewPollAddress	The argument value holds the new address for a device. The allowed values are 0..63.
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.
ServiceError	1: OK / function started asynchronously, result has to be polled with EndSetAddress 0: OK / execution finished successfully -1: SetAddress Failed / cancelled 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

5.6.2.7 Scan

The method signature specified in IEC 62769-7 applies. The HART Gateway business logic shall create the scan result using the following EDD definitions, which shall be included in the communication device COMPONENT definition. The EDD LIST also held in the COMPONENT holds the list of devices corresponding to the data structure defined in the XML schema. This LIST shall be referred to by the SCAN_LIST attribute of the communication device component. The corresponding topologyScanResult schema is specified in Annex A.

```
VARIABLE DevAddr
{
    LABEL "Address";
    CLASS DEVICE;
    TYPE UNSIGNED_INTEGER(5);
    HANDLING READ & WRITE;
}
```

```
VARIABLE DevMfg
{
    LABEL "Manufacturer";
    CLASS DEVICE;
    TYPE UNSIGNED_INTEGER(2);
    HANDLING READ & WRITE;
}
```

```
VARIABLE DevType
{
  LABEL "Device Type";
  CLASS DEVICE;
  TYPE UNSIGNED_INTEGER(2);
  HANDLING READ & WRITE;
}

VARIABLE DevRev
{
  LABEL "Device Revision";
  CLASS DEVICE;
  TYPE UNSIGNED_INTEGER;
  HANDLING READ & WRITE;
}

VARIABLE DevTag
{
  LABEL "Tag";
  CLASS DEVICE;
  TYPE ASCII(32);
  HANDLING READ & WRITE;
}

COLLECTION ScanItemType_TP
{
  MEMBERS
  {
    ADDRESS, DevAddr;
  }
}

COLLECTION DeviceIdentificationType
{
  MEMBERS
  {
    MFG,          DevMfg;
    DEV_TYPE,    DevType;
    DEV_REV,     DevRev;
    TAG,         DevTag;
  }
}

COLLECTION ScanResultType
{
  MEMBERS
  {
    ScanItem,          ScanItemType_TP;
    DeviceIdentification, DeviceIdentificationType;
  }
}

LIST TopologyScanResult
{
  TYPE ScanResultType;
  CAPACITY 64; //Defined to limitation of the comm. device
}
```

5.6.2.8 ScanNext

The method signature specified in IEC 62769-7 applies. The HART Gateway business logic shall create the scan result using the same EDD definitions defined in 5.6.2.7. The corresponding topologyScanResult schema is specified in Annex A.

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Annex A (normative)

Topology scan schema

A.1 General

The Topology scan result schema specified in Annex A describes the HART 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 IdentificationType

The element content corresponds to the "FunctionalGroup Identification".

The XML schema for IdentificationType is:

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```

<xs:complexType name="IdentificationT">
  <xs:attribute name="MANUFACTURER_ID" type="xs:unsignedShort"
use="required">
  </xs:attribute>
  <xs:attribute name="DEVICE_TYPE" type="xs:unsignedShort"
use="required">
  </xs:attribute>
  <xs:attribute name="UNIVERSAL_REVISION" type="xs:unsignedByte"
use="required">
  </xs:attribute>
  <xs:attribute name="DEVICE_REVISION" type="xs:unsignedByte"
use="required">
  </xs:attribute>
  <xs:attribute name="SERIAL_NUMBER" use="required">
  <xs:simpleType>
    <xs:restriction base="xs:unsignedInt">
      <xs:minInclusive value="0"/>
      <xs:maxInclusive value="1677721616777215"/>
    </xs:restriction>
  </xs:simpleType>
</xs:attribute>
  <xs:attribute name="HARDWARE_REVISION" use="required">
  <xs:simpleType>
    <xs:restriction base="xs:unsignedByte">
      <xs:minInclusive value="0"/>
      <xs:maxInclusive value="31"/>
    </xs:restriction>
  </xs:simpleType>
</xs:attribute>
  <xs:attribute name="SOFTWARE_REVISION" type="xs:unsignedByte"
use="required">
  </xs:attribute>
  <xs:attribute name="REV_COUNTER" type="xs:unsignedShort"
default="0">
  </xs:attribute>
  <xs:attribute name="TAG" use="required">
  <xs:simpleType>
    <xs:restriction base="xs:string">
      <xs:maxLength value="32"/>
    </xs:restriction>
  </xs:simpleType>
</xs:attribute>
</xs:complexType>

```

The attributes of IdentificationType are described in Table A.1.

Table A.1 – Attributes of IdentificationT

Attribute	Description
MANUFACTURER_ID	<p>Manufacturer identification number.</p> <p>For HART universal revision 7 or higher devices: 2-byte manufacturer code of a device, returned in bytes 17 and 18 of Command 0 or Command 11 or Command 21.</p> <p>For HART revision 6 or lower devices: Most significant byte shall be fixed to 0, and the least significant byte is returned in byte 1 of Command 0 or Command 11 or Command 21</p>
DEVICE_TYPE	<p>Manufacturer's model number associated with the resource.</p> <p>For HART universal revision 7 or higher devices: 2 byte device type returned in bytes 1 and 2 of Command 0 or Command 11 or Command 21</p> <p>For HART revision 6 or lower devices: Most significant byte shall be fixed to 0, and the least significant byte is returned in byte 2 of Command 0 or Command 11 or Command 21</p>
UNIVERSAL_REVISION	<p>Universal HART revision associated with the device. Returned in byte 4 of Command 0 or Command 11 or Command 21</p>
DEVICE_REVISION	<p>Manufacturer's device revision number associated with the device. Returned in byte 5 of Command 0 or Command 11 or Command 21</p>
SERIAL_NUMBER	<p>Unique serial number of the device. 3-byte unique ID of a device, returned in bytes 9 to 11 of Command 0 or Command 11 or Command 21</p>
HARDWARE_REVISION	<p>Manufacturer hardware revision associated with the device. Returned in byte 7 (only 5 most significant bits) of Command 0 or Command 11 or Command 21</p>
SOFTWARE_REVISION	<p>Manufacturer firmware revision associated with the device. Returned in byte 6 of Command 0 or Command 11 or Command 21</p>
REV_COUNTER	<p>The configuration change counter associated with the device.</p> <p>For HART universal revision 6 or higher devices: Returned in bytes 14 and 15 of Command 0 or Command 11 or Command 21.</p> <p>For HART revision 5 or lower devices: -1 (not defined).</p>
TAG	<p>The configured Identification tag associated with the device.</p> <p>For HART universal revision 6 or higher devices: 32 character long tag returned in Command 20 or Command 21.</p> <p>For HART revision 5 or lower devices: 8 character tag returned in Command 11 or Command 13.</p>

A.3 AddressTypeTP

The XML schema for AddressTypeTP is:

```
<xs:complexType name="AddressTypeTP">
  <xs:complexContent>
    <xs:extension base="hart:LongAddressT">
      <xs:sequence>
        <xs:element name="DevPollAddr" minOccurs="0">
          <xs:simpleType>
            <xs:restriction base="xs:unsignedByte">
              <xs:minInclusive value="0"/>
              <xs:maxInclusive value="63"/>
            </xs:restriction>
          </xs:simpleType>
        </xs:element>
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```

The elements of AddressTypeTP are described in Table A.2.

Table A.2 – Elements of AddressTypeTP

Element	Description
DevAddr	Holds the 5-byte HART address of the associated device.
DevPollAddr	Holds the HART short address used for polling the associated device.

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A.4 AddressTypeIP

The XML schema for AddressTypeIP is:

```
<xs:simpleType name="IPv4T">
  <xs:restriction base="xs:string">
    <xs:pattern value="((25[0-5]|2[0-4][0-9]|[01]?[0-9][0-9]?)\.) {3} (25[0-5]|2[0-4][0-9]|[01]?[0-9][0-9]?)"/>
  </xs:restriction>
</xs:simpleType>

<xs:simpleType name="IPv6T">
  <xs:restriction base="xs:string">
    <xs:pattern value="([A-Fa-f0-9]{1,4}:){7}[A-Fa-f0-9]{1,4}" />
  </xs:restriction>
</xs:simpleType>

<xs:complexType name="AddressTypeIP">
  <xs:complexContent>
    <xs:extension base="hart:LongAddressT">
      <xs:sequence>
        <xs:choice>
          <xs:element name="IPv4Address" type="hart:IPv4T">
          </xs:element>
          <xs:element name="IPv6Address" type="hart:IPv6T">
          </xs:element>
        </xs:choice>
        <xs:element name="IPPort" type="xs:unsignedShort">
        </xs:element>
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```

The elements of AddressTypeIP are described in Table A.3.

Table A.3 – Elements of AddressTypeIP

Element	Description
DevAddr	Holds the 5-byte HART address of the associated device.
IPAddress	Holds the network IP address of the associated device.
IPPort	Holds the IP Port number used for the associated device.

A.5 AddressTypeTDMA

The XML schema for AddressTypeTDMA is:

```
<xs:complexType name="AddressTypeTDMA">
  <xs:complexContent>
    <xs:extension base="hart:LongAddressT">
      <xs:sequence>
        <xs:element name="NetworkID" type="xs:unsignedShort">
        </xs:element>
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```

The elements of AddressTypeTDMA are described in Table A.4.

Table A.4 – Elements of AddressTypeTDMA

Element	Description
DevAddr	Holds the 5-byte HART address of the associated device.
IPAddress	Holds the network IP address of the associated device.
IPVersion	Holds the IP version number used for the associated device (either version 4 or 6).
IPPort	Holds the IP Port number used for the associated device.

A.6 AddressType

The XML schema for AddressType is:

```

<xs:complexType name="AddressT">
  <xs:choice>
    <xs:element name="AddressTP" type="hart:AddressTypeTP">
    </xs:element>
    <xs:element name="AddressIP" type="hart:AddressTypeIP">
    </xs:element>
    <xs:element name="AddressTDMA" type="hart:AddressTypeTDMA">
    </xs:element>
  </xs:choice>
</xs:complexType>

<xs:complexType name="LongAddressT">
  <xs:sequence>
    <xs:element name="DevAddr">
      <xs:simpleType>
        <xs:restriction base="xs:string">
          <xs:pattern value="([A-Fa-f0-9]{10})"/>
        </xs:restriction>
      </xs:simpleType>
    </xs:element>
  </xs:sequence>
</xs:complexType>
  
```

The elements of AddressType are described in Table A.5.

Table A.5 – Elements of AddressT

Element	Description
AddressTP	Token passing addresses hold the address information used for ConnectionPointType_HART_TP5, 6, or 7 described in 5.5.1.2.
AddressIP	IP addresses hold the address information described in ConnectionPointType_HART_IP described in 5.5.1.2.
AddressTDMA	TDMA addresses hold the address information described in ConnectionPointType_HART_TDMA described in 5.5.1.2.

A.7 ConnectionPointType

The XML schema for ConnectionPointType is:

```
<xs:complexType name="ConnectionPointT">
  <xs:sequence>
    <xs:element name="Identification" type="hart:IdentificationT">
      </xs:element>
    <xs:element name="Address" type="hart:AddressT">
      </xs:element>
    </xs:sequence>
  </xs:complexType>
```

The elements of a ConnectionPointType are described in Table A.6.

Table A.6 – Elements of ConnectionPointT

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.
Address	The address element holds the specific information used to uniquely address the device in the network. The address will be one of three possible types described by AddressType.

A.8 NetworkType

The element type describes the complete scan result for a single network because of the scan method that is provided per instance of a "Communication Device" which exists in a 1:1 relation to a network instance.

The XML schema for a NetworkType is:

```
<xs:complexType name="NetworkT">
  <xs:sequence>
    <xs:element name="ConnectionPoint" type="hart:ConnectionPointT"
      maxOccurs="unbounded">
      </xs:element>
    </xs:sequence>
  </xs:complexType>
```

The elements of a NetworkType are described in Table A.7.

Table A.7 – Elements of NetworkT

Element	Description
ConnectionPoint	The ConnectionPoint element holds the address and identification of the network connected device that has been found during bus scan operations.

A.9 Network

The subsequent element hierarchy is used to return the scan result according to the Information Model (IEC 62769-5) representation of a topology.

The XML schema for a Network element is:

```
<xs:element name="Network" type="hart:NetworkT">  
</xs:element>
```

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Annex B (normative)

Transfer service parameters

B.1 General

Direct Access Services specified in IEC 62769-2 enable the User Interface Plug-in (UIP) to directly exchange data with the device. Direct data exchange means that data exchanged between a device and a UIP may not be reflected in the Information Model. The IEC 62769-6 defined interface IDirectAccess corresponds to the IEC 62769-2 specified Direct Access Services. Interface IDirectAccess defined functions BeginTransfer and EndTransfer need to convey protocol specific information. The following XML schema documents the protocol specifics.

B.2 receiveData

The element described in the following contains data that is returned through IDirectAccess function Endtransfer and GetPublishedData defined return value.

```
<xs:element name="receiveData" type="hart:TransferResultDataT">
</xs:element>
```

B.3 sendData

The element described in the following contains data to be submitted through IDirectAccess function Begintransfer defined argument sendData.

```
<xs:element name="sendData" type="hart:TransferSendDataT">
</xs:element>
```

B.4 TransferResultDataT

The XML element type defines the service parameter data format that shall be applied to the EndTransfer and GetPublishedData defined return value. The attribute names defined in TransferResultDataType correspond to same name of Transfer method arguments specified in 5.6.1.4 and 5.6.2.4.

```
<xs:complexType name="TransferResultDataT">
  <xs:attribute name="COMMAND" type="xs:unsignedInt"
use="required">
  </xs:attribute>
  <xs:attribute name="REPLY" type="xs:hexBinary" use="required">
  </xs:attribute>
</xs:complexType>
```

~~The attributes of TransferResultDataType are described in Table B.1.~~

Table B.1 defines the attributes of TransferResultDataT.

Table B.1 – Attributes of TransferResultDataT

Attribute	Description
COMMAND	The attribute corresponds to the CP9/1 command number.
REPLY	The attribute corresponds to the REPLY data bytes in the CP9/1 command data field.

B.5 TransferSendDataT

The XML element type defines the service parameter data format that shall be applied to BeginTransfer defined argument sendData. The attribute names defined in TransferSendDataType correspond to the same name of Transfer method arguments specified in 5.6.1.4 and 5.6.2.4.

```
<xs:complexType name="TransferSendDataT">
  <xs:attribute name="COMMAND" type="xs:unsignedInt"
use="required">
  </xs:attribute>
  <xs:attribute name="REQUEST" type="xs:hexBinary" use="required">
  </xs:attribute>
</xs:complexType>
```

~~The attributes of TransferSendDataType are described in Table B.2.~~

Table B.2 defines the attributes of TransferSendDataT

Table B.2 – Attributes of TransferSendDataT

Attribute	Description
COMMAND	The attribute corresponds to the CP9/1 command number.
REQUEST	The attribute corresponds to the REQUEST data bytes in the CP9/1 command data field.

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Annex C (informative)

Mapping to PA DIM

C.1 General

IEC 62769-8 specifies how the internal view of a device model represented by the EDD can be transferred into an external view as an OPC-UA information model by mapping EDD constructs to OPC-UA objects. This Annex C gives an overview on the mapping of standard parameters defined in HART to PA DIM.

C.2 Mapping Table

Table C.1 specifies the parameters, for which a direct mapping exists. Other parameters such as the AssetId cannot be mapped directly. In these cases manufacturer specific variables might be used.

Table C.1 – Mapping from HART standard parameters to PA DIM

Usage	PA-DIM BrowsePath	IEC 61987 CDD	Mappable HART Standard Parameters
Identification	ProductInstanceUri	0112/2///61987#ABN590#001	--
Identification	Manufacturer	0112/2///61987#ABA565#007	manufacturer_id
Identification	ProductCode	0112/2///61987#ABA300#006	--
Identification	Model	0112/2///61987#ABA567#007	device_type
Identification	SerialNumber	0112/2///61987#ABA951#007	--
Identification	HardwareRevision	0112/2///61987#ABA926#006	hardware_revision
Identification	SoftwareRevision	0112/2///61987#ABA601#006	software_revision
Identification	RevisionCounter	0112/2///61987#ABN603#001	config_change_counter
AssetId (User Tag of Device)	AssetId	0112/2///61987#ABA038#003	longTag
DeviceHealth	DeviceHealth	0112/2///61987#ABN972#001	--

Bibliography

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), *Devices and integration in enterprise systems – Function blocks (FB) for process control and electronic device description language (EDDL)*

IEC 62769 (all parts), *Field device integration (FDI[®])*

IEC 62769-1, *Field device integration (FDI[®]) – Part 1: Overview*

IEC 62769-2, *Field device integration (FDI[®]) – Part 2: FDI[®] Client*

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

IEC 62769-6, *Field device integration (FDI[®]) – Part 6: ~~FDI~~ Technology Mapping*

IEC 62769-8, *Field device integration (FDI[®]) – Part 8: EDD to OPC-UA Mapping*

~~HCF_SPEC-13, *HART[®] Field Communication Protocol Specification*, available at
<<http://www.fieldcommgroup.org>> [viewed 2018-11-30]~~

~~HCF_SPEC-99, *Command Summary Specification*, available at
<<http://www.fieldcommgroup.org>> [viewed 2018-11-30]~~

~~HCF_SPEC-127, *Universal Command Specification*, available at
<<http://www.fieldcommgroup.org>> [viewed 2018-11-30]~~

~~HCF_SPEC-151, *Common Practice Command Specification*, available at
<<http://www.fieldcommgroup.org>> [viewed 2018-11-30]~~

IETF RFC 768, *User Datagram Protocol*, available at <<http://www.ietf.org>>

IETF RFC 793, *Transmission Control Protocol*, available at <<http://www.ietf.org>>

FCG AG21073⁵, *HART DeviceInfo – Technical Overview*

⁵ To be published.

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Field device integration (FDI)[®] –
Part 109-1: Profiles – HART[®] and WirelessHART[®]**

**Intégration des appareils de terrain (FDI)[®] –
Partie 109-1: Profils – HART[®] et WirelessHART[®]**

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CONTENTS

FOREWORD.....	4
1 Scope.....	6
2 Normative references	6
3 Terms, definitions, abbreviated terms and acronyms	6
3.1 Terms and definitions.....	6
3.2 Abbreviated terms and acronyms	7
4 Conventions	7
4.1 EDDL syntax.....	7
4.2 XML syntax.....	7
4.3 Capitalizations	7
5 Profile for CP 9/1 (HART®) or CP 9/2 (WirelessHART®).....	8
5.1 General.....	8
5.2 Catalog profile	8
5.2.1 Protocol support file.....	8
5.2.2 CommunicationProfile definition.....	8
5.2.3 Profile device.....	9
5.2.4 Protocol version information	9
5.3 Associating a Package with a CP 9/1 device	10
5.3.1 Device type identification mapping.....	10
5.3.2 Device type revision mapping	10
5.4 Information Model mapping.....	10
5.4.1 ProtocolType definition	10
5.4.2 DeviceType mapping	10
5.4.3 FunctionalGroup Identification definition	11
5.5 Topology elements.....	11
5.5.1 ConnectionPoint definition	11
5.5.2 Communication Device definition	17
5.5.3 Communication service provider definition	18
5.5.4 Network definition.....	19
5.6 Methods	20
5.6.1 Methods for FDI® Communication Servers	20
5.6.2 Methods for Gateways	24
Annex A (normative) Topology scan schema.....	33
A.1 General.....	33
A.2 IdentificationType	33
A.3 AddressTypeTP	36
A.4 AddressTypeIP	37
A.5 AddressTypeTDMA.....	37
A.6 AddressType.....	38
A.7 ConnectionPointType.....	39
A.8 NetworkType.....	39
A.9 Network	40
Annex B (normative) Transfer service parameters.....	41
B.1 General.....	41
B.2 receiveData	41
B.3 sendData	41

B.4	TransferResultDataT.....	41
B.5	TransferSendDataT.....	42
Annex C (informative)	Mapping to PA DIM	43
C.1	General.....	43
C.2	Mapping Table	43
Bibliography	44
Table 1	– Device Information Files	8
Table 2	– CommunicationProfile definition	9
Table 3	– Catalog values for profile devices.....	9
Table 4	– Protocol Version Information	9
Table 5	– Device type catalog mapping.....	10
Table 6	– ProtocolType HART definition	10
Table 7	– Inherited DeviceType Property mapping	11
Table 8	– Identification parameters	11
Table 9	– ConnectionPointType HART_TP definition.....	12
Table 10	– ConnectionPointType HART_IP Definition	15
Table 11	– ConnectionPointType HART_TDMA Definition	17
Table 12	– Method Connect arguments.....	21
Table 13	– Method Disconnect arguments	21
Table 14	– Method Transfer arguments.....	22
Table 15	– Method GetPublishedData arguments.....	23
Table 16	– Method SetAddress arguments.....	24
Table 17	– Method Connect arguments.....	25
Table 18	– Method Disconnect arguments	26
Table 19	– Method Transfer arguments.....	27
Table 20	– Method GetPublishedData arguments.....	29
Table 21	– Method SetAddress arguments.....	30
Table A.1	– Attributes of IdentificationT	35
Table A.2	– Elements of AddressTypeTP	36
Table A.3	– Elements of AddressTypeIP	37
Table A.4	– Elements of AddressTypeTDMA.....	38
Table A.5	– Elements of AddressT	38
Table A.6	– Elements of ConnectionPointT	39
Table A.7	– Elements of NetworkT	39
Table B.1	– Attributes of TransferResultDataT	41
Table B.2	– Attributes of TransferSendDataT.....	42
Table C.1	– Mapping from HART standard parameters to PA DIM.....	43

INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIELD DEVICE INTEGRATION (FDI®) –

Part 109-1: Profiles – HART® and WirelessHART®

FOREWORD

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IEC 62769-109-1 has been prepared by subcommittee 65E: Devices and integration in enterprise systems, of IEC technical committee 65: Industrial-process measurement, control and automation. It is an International Standard.

This third edition cancels and replaces the second edition published in 2020. This edition constitutes a technical revision.

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

- a) added content type for DeviceInfo files;
- b) added mapping from HART standard parameters to PA DIM;

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

Draft	Report on voting
65E/864/CDV	65E/921/RVC

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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FIELD DEVICE INTEGRATION (FDI®) –

Part 109-1: Profiles – HART® and WirelessHART®

1 Scope

This part of IEC 62769 specifies an FDI®¹ profile of IEC 62769 for IEC 61784-1_CP 9/1 (HART®)² and IEC 61784-1_CP 9/2 (WirelessHART®)³.

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 62541-100, *OPC Unified Architecture Specification – Part 100: OPC Device Interface*

IEC 62769-4, *Field device integration (FDI®) – Part 4: FDI® Packages*

IEC 62769-5, *Field device integration (FDI®) – Part 5: Information Model*

IEC 62769-7, *Field device integration (FDI®) – Part 7: Communication devices*

3 Terms, definitions, abbreviated terms and acronyms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62541-100, IEC 62769-4, IEC 62769-5 and IEC 62769-7 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>

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3.2 Abbreviated terms and acronyms

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

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 the IEC 61804 series)
EDDL	Electronic device description language (see the IEC 61804 series)
FDI [®]	Field device integration
FSK	Frequency-Shift-Keying
HCF	HART Communication Foundation
ID	Identification
IM	Information Model
IP	Internet protocol
PDU	Protocol data unit
PSK	Phase-Shift-Keying
TCP	Transmission Control Protocol (see IETF RFC 793)
UDP	User Datagram Protocol (see IETF RFC 768)
XML	Extended markup language

4 Conventions

4.1 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.

4.2 XML syntax

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

Example: `<xs:simpleType name="ExampleT">`

4.3 Capitalizations

The IEC 62769 series uses capitalized terms to emphasize that these terms have an FDI[®] specific meaning.

Some of these terms using an acronym as a prefix, for example

- FDI[®] Client or
- FDI[®] Server.

Some of these terms are compound terms such as:

- FDI[®] Communication Servers or
- Profile Package.

Parameter names or attributes are concatenated to a single term, where the original terms start in this term with a capital letter such as:

- ProtocolSupportFile or

- ProtocolType.

Parameter names or attributes can also be constructed by using an underscore character to concatenate two or more terms like:

- PROFILE_ID or
- HART_Network

5 Profile for CP 9/1 (HART®) or CP 9/2 (WirelessHART®)

5.1 General

This profile document to the FDI® specification in IEC 62769 selects the protocol specifics needed for FDI® Packages describing FDI® Communication Servers, gateways and devices.

Annex B defines the XML schema for Direct Access Services. Annex C provides an overview of mapping PROFIBUS standard parameters to PA DIM.

5.2 Catalog profile

5.2.1 Protocol support file

Device information files provide metadata for the dynamic runtime data that is supplied by the device. This metadata is a subset of information that is contained in the EDD. The device information files may be extracted from the package by light-weight gateway or server implementations to exchange runtime device information with minimal implementation overhead. Device information files do not replace the need for the EDD part because device information files only contain a subset of the information from the EDD, and do not provide any user-interface elements.

The formats of the Device Information Files are described in Table 1.

Table 1 – Device Information Files

Part	Content
Content Type	application/vnd.hart.json
Root Namespace	Not specified here
Source Relationship	http:// fdi-cooperation.com/2010/relationships/attachment-protocol
Filename	Not specified here

The Device Information Files are specified in FCG AG21073.

5.2.2 CommunicationProfile definition

IEC 62769-4 defines a CommunicationProfileT string type for the Catalog XML schema. Table 2 defines the CP 9/1 specific values for this enumeration.

Table 2 – CommunicationProfile definition

CommunicationProfile	Description
hart_fsk	CP 9/1 device type that supports an FSK physical layer (Frequency-Shift-Keying on a pair of wires)
hart_psk	CP 9/1 device type that supports a PSK physical layer (Phase-Shift-Keying on a pair of wires). Devices supporting PSK are required to also inherently support FSK, and therefore PSK will always be used only in combination with at least FSK.
hart_wirelesshart	CP 9/2 device type that supports a wireless physical layer (communication between device and gateway).
hart_ip	CP 9/1 device type that supports Internet Protocol (these devices support both TCP and UDP).
hart_rs485	CP 9/1 device type that supports EIA-485 digital communication.
hart_ir	CP 9/1 device type that supports an Infrared physical layer (designed to be transparent to FSK masters – included only as information to indicate that the device supports IR connection).
NOTE It is possible for a single CP 9/1 device to support more than one CP.	

5.2.3 Profile device

A Profile Package shall provide the catalog values for profile devices, enabling the FDI® Server to leverage a generic device description, if a specific one is not available. The definitions in Table 3 focus on catalog content that is vendor independent.

Table 3 – Catalog values for profile devices

Element	Attribute	Content
PackageType	—	Profile
DeviceModel	—	Empty
Manufacturer	—	Empty

5.2.4 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 has to follow the IEC 62769-4 defined version information schema defined in element type VersionT. Subclause 5.2.4 describes how to apply the currently known protocol versions for CP 9/1 or CP 9/2 entries in the device catalog. The general rule is to use the Universal Revision of the protocol for the major version part of VersionT, and the value “0” for the minor version and build parts. Table 4 shows the Protocol Version Information.

Table 4 – Protocol Version Information

Protocol Version	InterfaceT Version value
HART Universal Revision 5	5.0.0
HART Universal Revision 6	6.0.0
HART Universal Revision 7	7.0.0
The Protocol Version defined in a package is provided for informational purposes only, and shall not be used to determine the compatibility or applicability of a package to a device.	

5.3 Associating a Package with a CP 9/1 device

5.3.1 Device type identification mapping

CP 9/1 device types are uniquely identified by parameters Manufacturer, Model and DeviceRevision. 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 5.

Table 5 – Device type catalog mapping

Catalog element	CP mapping (See Table A.1)
Manufacturer element of InterfaceT (IEC 62769-4:2023, Clause E.11)	Manufacturer String format "0xddd" where dddd is the MANUFACTURER_ID in hexadecimal format.
DeviceModel element of InterfaceT (IEC 62769-4:2023, Clause E.11)	Model String format "0xddd" where dddd is the DEVICE_TYPE in hexadecimal format.
DeviceRevision element ListOfSupportedDeviceRevisionsT (IEC 62769-4:2023, Clause E.20)	DeviceRevision String format "x.0.0" where x is the DEVICE_REVISION in decimal format (no leading zeros).

5.3.2 Device type revision mapping

Each device type is identified as per 5.3.1. If a package with matching DeviceRevision is not available, any CP 9/1 FDI® package for a corresponding manufacturer and model shall always be compatible with a field device as long as the device revision of the field device is equal to or greater than the device revision specified in the FDI® package.

5.4 Information Model mapping

5.4.1 ProtocolType definition

Table 6 defines the ProtocolType used to identify CP 9/1 network communications.

Table 6 – ProtocolType HART definition

Attribute	Value				
BrowseName	HART				
IsAbstract	False				
References	NodeClass	BrowseName	Data Type	TypeDefinition	ModellingRule
Inherits the properties of ProtocolType defined in IEC 62541-100					

5.4.2 DeviceType mapping

Each device type inherits the properties of DeviceType. The mapping of the inherited properties from DeviceType is defined in Table 7.

Table 7 – Inherited DeviceType Property mapping

Property	Foundation mapping
SerialNumber	Unique ID of a device, mapped to SERIAL_NUMBER of IdentificationT.
RevisionCounter	Configuration change counter, mapped to REV_COUNTER of IdentificationT
Manufacturer	String taken from FDI [®] package catalog (ManufacturerName from PackageT)
Model	String taken from FDI [®] package catalog (Name of DeviceTypeT, which is a localized name)
DeviceManual	Entry text string (not supported) ^a
DeviceRevision	Device revision level of a device, mapped to DEVICE_REVISION of IdentificationT
SoftwareRevision	Software revision level of a device, mapped to SOFTWARE_REVISION of IdentificationT
HardwareRevision	Hardware revision level of a device, mapped to HARDWARE_REVISION of IdentificationT
^a Device manuals are exposed as attachments of the FDI [®] Device Package.	

5.4.3 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 device type instance. The FunctionalGroup Identification for CP 9/1 is defined in Table 8.

Table 8 – Identification parameters

BrowseName	Data Type	Optional/Mandatory
MANUFACTURER_ID	UInt16	Mandatory
DEVICE_TYPE	UInt16	Mandatory
DEVICE_REVISION	UInt8	Mandatory
UNIVERSAL_REVISION	UInt8	Optional
SERIAL_NUMBER	UInt24	Optional
HARDWARE_REVISION	UInt8	Optional
SOFTWARE_REVISION	UInt8	Optional
REVISION_COUNTER	UInt16	Optional

5.5 Topology elements

5.5.1 ConnectionPoint definition

5.5.1.1 General

CP 9/1 devices can support up to five different ConnectionPoint types that are used for network communications.

5.5.1.2 HART_TP5, HART_TP6, HART_TP7

The ConnectionPoint types HART_TP5, HART_TP6, and HART_TP7 shall be used to identify CP 9/1 token passing network communication and are defined in Table 9. HART_TP5, HART_TP6, and HART_TP7 all contain the same properties, but each provides different

qualification information for some of the properties (described below). The Protocol Version (UNIVERSAL_REVISION) described in 5.2.3 can be used as an aid to determine which of the three token passing Connection Point types is the most appropriate. CP 9/1 token passing communications can be used on a variety of physical layers. FSK, PSK, RS485, and Infrared physical layer connections shall all use the HART_TP connection type. The ConnectionPoint types HART_TP5, HART_TP6, and HART_TP7 are subtypes of abstract type ConnectionPointType defined in IEC 62769-5.

The DevAddr property shall be the long address (5 bytes) for the device, and is the only parameter necessary to communicate with the field device.

The DevMfg property shall be the 2-byte Manufacturer ID, and can be used to help automate the process of assigning live devices in the scan list to offline placeholders.

The DevType property shall be the 2-byte extended device type, and can be used to help automate the process of assigning live devices in the scan list to offline placeholders.

The DevRev property shall be the device revision, and can be used to help automate the process of assigning live devices in the scan list to offline placeholders.

The DevTag property shall be the long tag for HART® protocol version 6 or 7 devices. The DevTag property shall be the tag for protocol version 5 devices. The DevTag property can be used to help automate the process of assigning live devices in the scan list to offline placeholders. HART_TP5 Connection Points shall limit the DevTag to 8 characters in length. HART_TP6 and HART_TP7 Connection Points shall limit the DevTag to 32 characters in length.

The DevPollAddr property shall be the poll address, and can be used to identify which device is located at a specific poll address. HART_TP5 Connection Points shall be limited to values between 0 and 15 for the DevPollAddr property. HART_TP6 Connection Points shall be limited to values between 0 and 31 for the DevPollAddr property. HART_TP7 Connection Points shall be limited to values between 0 and 63 for the DevPollAddr property.

For forward compatibility, a lower revision HART_TP Connection Point is compatible and can be used for a higher universal revision device connection. For example, if a future HART universal revision 8 device is encountered, and no HART_TP8 is available in the FDI® server, HART_TP7 will be compatible and shall be used to connect to the device. If the Protocol Version (i.e. the Universal Revision) is unknown for any reason, the HART_TP5 Connection Point can be used, and will be forward compatible to later universal revisions.

Table 9 – ConnectionPointType HART_TP definition

Attribute	Value				
BrowseName	ConnectionPoint_HART_TP5 or ConnectionPoint_HART_TP6 or ConnectionPoint_HART_TP7				
IsAbstract	False				
References	NodeClass	BrowseName	Data Type	TypeDefinition	ModellingRule
Inherits the properties of ConnectionPointType defined in IEC 62769-5					
HasProperty	Variable	DevAddr	UInt40	PropertyType	Mandatory
HasProperty	Variable	DevMfg	UInt16	PropertyType	Optional
HasProperty	Variable	DevType	UInt16	PropertyType	Optional
HasProperty	Variable	DevRev	UInt16	PropertyType	Optional
HasProperty	Variable	DevTag	String	PropertyType	Optional
HasProperty	Variable	DevPollAddr	UInt8	PropertyType	Optional

The ConnectionPoint type HART_TP5, HART_TP6, and HART_TP7 shall be described by an EDD element contained in a Communication Device related FDI® Package that can drive a CP 9/1 network. Actual ConnectionPoint properties are declared by VARIABLE constructs grouped together in a COLLECTION named ConnectionPoint_HART_TP5, ConnectionPoint_HART_TP6, or ConnectionPoint_HART_TP7. The following EDDL source code is an example describing a TP5 Connection Point.

```
COMPONENT ConnectionPoint_HART_TP5
{
  LABEL "HART TP Connection Point";
  CLASSIFICATION NETWORK_CONNECTION_POINT;
  CAN_DELETE FALSE;
  PROTOCOL HART;
  CONNECTION_POINT ConnectionPoint_TP5;
}

VARIABLE DevAddr
{
  LABEL "Address";
  CLASS DEVICE;
  TYPE UNSIGNED_INTEGER(5);
  HANDLING READ & WRITE;
}

VARIABLE DevMfg
{
  LABEL "Manufacturer";
  CLASS DEVICE;
  TYPE UNSIGNED_INTEGER(2);
  HANDLING READ & WRITE;
}

VARIABLE DevType
{
  LABEL "Device Type";
  CLASS DEVICE;
  TYPE UNSIGNED_INTEGER(2);
  HANDLING READ & WRITE;
}

VARIABLE DevRev
{
  LABEL "Device Revision";
  CLASS DEVICE;
  TYPE UNSIGNED_INTEGER;
  HANDLING READ & WRITE;
}

VARIABLE DevTag
{
  LABEL "Tag";
  CLASS DEVICE;
  TYPE ASCII(32);
  HANDLING READ & WRITE;
}
```

```

VARIABLE DevPollAddr
{
  LABEL "Poll Address";
  CLASS DEVICE;
  TYPE UNSIGNED_INTEGER
  {
    MAX_VALUE 15; //Define appropriate max value for various revisions
  }
  HANDLING READ & WRITE;
}

COLLECTION ConnectionPoint_TP5
{
  LABEL "Connection Point";
  MEMBERS
  {
    ADDRESS,      DevAddr,      "Device Address";
    MFG,          DevMfg,       "Manufacturer";
    DEV_TYPE,     DevType,      "Device Type";
    DEV_REV,      DevRev,       "Device Revision";
    TAG,          DevTag,       "Device Tag";
    POLL_ADDR,   DevPollAddr,  "Poll Address";
  }
}

```

5.5.1.3 HART_IP

The ConnectionPoint type HART_IP shall be used to identify CP 9/1 IP network communication and is defined in Table 10. HART_IP communications can be used on a variety of physical layers. Ethernet connections shall all use the HART_IP connection type. Additional physical layers developed in the future may also use the HART_IP connection type. The ConnectionPoint type HART_IP is a subtype of abstract type ConnectionPointType defined in IEC 62769-5.

The IPAddress property shall indicate the IP Address (up to 16 bytes) used for the connection.

The IPVersion property shall indicate the version of IP used for the connection (either 4 or 6).

The IPPort property shall be the IP port number for the connection. The default port number used for HART IP is 5094.

The DevAddr property shall be the long address (5 bytes) for the device.

The DevMfg property shall be the 2-byte Manufacturer ID, and can be used to help automate the process of assigning live devices in the scan list to offline placeholders.

The DevType property shall be the 2-byte extended device type, and can be used to help automate the process of assigning live devices in the scan list to offline placeholders.

The DevRev property shall be the device revision, and can be used to help automate the process of assigning live devices in the scan list to offline placeholders.

The DevTag property shall be the long tag (with maximum 32 characters), and can be used to help automate the process of assigning live devices in the scan list to offline placeholders.

Table 10 – ConnectionPointType HART_IP Definition

Attribute	Value				
BrowseName	ConnectionPoint_HART_IP				
IsAbstract	False				
References	NodeClass	BrowseName	Data Type	Type Definition	Modelling Rule
Inherits the properties of ConnectionPointType defined in IEC 62769-5					
HasProperty	Variable	IPAddress	ByteString	PropertyType	Mandatory
HasProperty	Variable	IPVersion	UInt8	PropertyType	Mandatory
HasProperty	Variable	IPPort	UInt16	PropertyType	Mandatory
HasProperty	Variable	DevAddr	UInt40	PropertyType	Mandatory
HasProperty	Variable	DevMfg	UInt16	PropertyType	Optional
HasProperty	Variable	DevType	UInt16	PropertyType	Optional
HasProperty	Variable	DevRev	UInt16	PropertyType	Optional
HasProperty	Variable	DevTag	String	PropertyType	Optional

The ConnectionPoint type HART_IP shall be described by an EDD element contained in a Communication Device related FDI® Package that can drive a CP 9/1 network. Actual ConnectionPoint properties are declared by VARIABLE constructs grouped together in a COLLECTION named ConnectionPoint_HART_IP. The following EDDL source code is an example describing an IP Connection Point.

```

COMPONENT ConnectionPoint_HART_IP
{
  LABEL "HART IP Connection Point";
  CLASSIFICATION NETWORK_CONNECTION_POINT;
  CAN_DELETE FALSE;
  PROTOCOL HART;
  CONNECTION_POINT ConnectionPoint_IP;
}

ARRAY IPAddress
{
  LABEL "IP Address";
  CLASS DEVICE;
  TYPE OCTET(16);
  HANDLING READ & WRITE;
}

VARIABLE IPVersion
{
  LABEL "IP Version";
  CLASS DEVICE;
  TYPE ENUMERATED
  {
    { 4, "IPv4" },
    { 6, "IPv6" }
  }
  HANDLING READ & WRITE;
}

```

```

}

VARIABLE IPPort
{
    LABEL "IP Port";
    CLASS DEVICE;
    TYPE UNSIGNED_INTEGER (2);
    DEFAULT_VALUE 5094;
    HANDLING READ & WRITE;
}

COLLECTION ConnectionPoint_IP
{
    LABEL "Connection Point";
    MEMBERS
    {
        IPADDRESS, IPAddress, "IP Address";
        IPVERSION, IPVersion, "IP Version";
        IPPORT, IPPort, "IP Port";
        ADDRESS, DevAddr, "Device Address";
        MFG, DevMfg, "Manufacturer";
        DEV_TYPE, DevType, "Device Type";
        DEV_REV, DevRev, "Device Revision";
        TAG, DevTag, "Device Tag";
    }
}

```

5.5.1.4 HART_TDMA

The ConnectionPoint type HART_TDMA shall be used to identify CP 9/2 time division media access network communication and is defined in Table 11. HART_TDMA communications can be used on a variety of physical layers. The ConnectionPoint type HART_TDMA is a subtype of abstract type ConnectionPointType defined in IEC 62769-5. WirelessHART connections shall all use the HART_TDMA connection type. Additional physical layers developed in the future may also use the HART_TDMA connection type.

The Network property shall be the network ID for the network.

The DevAddr property shall be the long address (5 bytes) for the device.

The DevMfg property shall be the 2 byte Manufacturer ID, and can be used to help automate the process of assigning live devices in the scan list to offline placeholders.

The DevType property shall be the 2 byte extended device type, and can be used to help automate the process of assigning live devices in the scan list to offline placeholders.

The DevRev property shall be the device revision, and can be used to help automate the process of assigning live devices in the scan list to offline placeholders.

The DevTag property shall be the long tag (with maximum 32 characters), and can be used to help automate the process of assigning live devices in the scan list to offline placeholders.

Table 11 – ConnectionPointType HART_TDMA Definition

Attribute	Value				
BrowseName	ConnectionPoint_HART_TDMA				
IsAbstract	False				
References	NodeClass	BrowseName	Data Type	Type Definition	Modelling Rule
Inherits the properties of ConnectionPointType defined in IEC 62769-5					
HasProperty	Variable	Network	UInt16	PropertyType	Mandatory
HasProperty	Variable	DevAddr	UInt40	PropertyType	Mandatory
HasProperty	Variable	DevMfg	UInt16	PropertyType	Optional
HasProperty	Variable	DevType	UInt16	PropertyType	Optional
HasProperty	Variable	DevRev	UInt16	PropertyType	Optional
HasProperty	Variable	DevTag	String	PropertyType	Optional

The ConnectionPoint type HART_TDMA shall be described by an EDD element contained in a Communication Device related FDI® Package that can drive a CP 9/2 network. Actual ConnectionPoint properties are declared by VARIABLE constructs grouped together in a COLLECTION named ConnectionPoint_HART_TDMA. The following EDDL source code is an example describing a TDMA Connection Point.

```

COMPONENT ConnectionPoint_HART_TDMA
{
  LABEL "HART TDMA Connection Point";
  CLASSIFICATION NETWORK_CONNECTION_POINT;
  CAN_DELETE FALSE;
  PROTOCOL HART;
  CONNECTION_POINT ConnectionPoint_TDMA;
}

VARIABLE Network
{
  LABEL "Network ID";
  CLASS DEVICE;
  TYPE UNSIGNED_INTEGER (2);
  HANDLING READ & WRITE;
}

COLLECTION ConnectionPoint_TDMA
{
  LABEL "Connection Point";
  MEMBERS
  {
    NETWORK, Network, "Network ID";
    ADDRESS, DevAddr, "Device Address";
    MFG, DevMfg, "Manufacturer";
    DEV_TYPE, DevType, "Device Type";
    DEV_REV, DevRev, "Device Revision";
    TAG, DevTag, "Device Tag";
  }
}

```

5.5.2 Communication Device definition

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

```
COMPONENT CommunicationServer_HART
{
  LABEL "HART Communication Server";
  CAN_DELETE TRUE;
  CLASSIFICATION NETWORK_COMPONENT;
  COMPONENT_RELATIONS { Communication_Device_Setup_HART}
}
```

```
COMPONENT_RELATION Communication_Device_Setup_HART
{
  LABEL "Relation between Device and Communication Device";
  RELATION_TYPE CHILD_COMPONENT;
  COMPONENTS
  {
    CommunicationDevice_HART{AUTO_CREATE 1;}
  }
  MINIMUM_NUMBER 1;
  MAXIMUM_NUMBER 4;
}
```

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 communication device component. The following EDDL source code is an example for a CP 9/1 communication device.

```
COMPONENT CommunicationDevice_HART
{
  LABEL "HART Communication Device";
  CAN_DELETE TRUE;
  CLASSIFICATION NETWORK_COMPONENT;
  COMPONENT_RELATIONS { ServiceProviderRelation_HART}
  BYTE_ORDER BIG_ENDIAN;
}
```

```
COMPONENT_RELATION ServiceProviderRelation_HART
{
  LABEL "Relation to communication service provider";
  RELATION_TYPE CHILD_COMPONENT;
  COMPONENTS
  {
    CommunicationServiceProvider_HART {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 CommunicationServerChannelType as described in IEC 62769-7.

5.5.3 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 9/1 communication service provider component.

The component reference (ConnectionPoint_HART_IP) corresponds to one of the related Connection Point definitions in 5.5.1. The attribute BYTE_ORDER value is to be set according to the protocol.

```

COMPONENT CommunicationServiceProvider_HART
{
  LABEL "HART Communication Service Provider";
  CAN_DELETE FALSE;
  CLASSIFICATION NETWORK_COMMUNICATION_SERVICE_PROVIDER;
  COMPONENT_RELATIONS { ServiceProviderConnectionPointRelation_HART }
  BYTE_ORDER BIG_ENDIAN;
}

COMPONENT_RELATION ServiceProviderConnectionPointRelation_HART
{
  LABEL "Relation between communication service and connection point";
  RELATION_TYPE CHILD_COMPONENT;
  ADDRESSING
  {
    IPAddress
  }
  COMPONENTS
  {
    ConnectionPoint_HART_IP { 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 CommunicationServiceType as described in IEC 62769-7.

5.5.4 Network definition

According to IEC 62769-7 each FDI[®] Communication Package shall contain at least one EDD element describing network configuration constraints using the component construct. The following EDDL source code is an example describing a network.

```

COMPONENT Network_HART
{
  LABEL "HART Network";
  CAN_DELETE TRUE;
  CLASSIFICATION NETWORK;
  COMPONENT_RELATIONS { NetworkConnectionPointRelation_HART }
}

```

```

COMPONENT_RELATION NetworkConnectionPointRelation_HART
{
  LABEL "Relation between network and connection point";
  RELATION_TYPE CHILD_COMPONENT;
  ADDRESSING {DevPollAddr}
  COMPONENTS
  {
    ConnectionPoint_HART_TP5
    {
      MAXIMUM_NUMBER 16;
    },
    ConnectionPoint_HART_TP6
    {
      MAXIMUM_NUMBER 32;
    },
    ConnectionPoint_HART_TP7
    {
      MAXIMUM_NUMBER 64;
    }
  }
  MINIMUM_NUMBER 1;
  MAXIMUM_NUMBER 64; //Defined to limitations of the comm. device
}

```

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 in IEC 62769-5. Some communication devices may organize multiple IO cards as individual networks, while others may present a single network that comprises all Connection Points across all IO cards.

5.6 Methods

5.6.1 Methods for FDI[®] Communication Servers

5.6.1.1 General

The FDI[®] Communication Server shall implement services according to the method signatures described in this section and according to the FDI[®] Information Model.

5.6.1.2 Connect

Table 12 shows the Method Connect arguments.

Signature:

```

Connect (
  [in]  ByteString CommunicationRelationId,
  [in]  ByteString LongAddress,
  [out] Int32      ServiceError);

```

Table 12 – 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 which is directly connected to the FDI [®] Communication Server hardware. The nodeId allows finding the direct parent-child relation.
LongAddress	The argument name shall match with the corresponding attribute name defined for the ConnectionPoint which is described by a corresponding EDD element specified in 5.5.1. The argument holds the device's long (5-byte) address. The value can be obtained by the method Scan.
ServiceError	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
NOTE 1 IEC 62769-7, defines the argument AddressData of the Connect Method as an array of Variant. The LongAddress arguments defined in the table are represented as entries of the Variant array in the order they are specified above.	
NOTE 2 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 for CP 9/1 devices.	

5.6.1.3 Disconnect

Table 13 shows the Method Disconnect arguments.

Signature:

```
Disconnect (
    [in] ByteString CommunicationRelationId,
    [out] Int32 ServiceError);
```

Table 13 – Method Disconnect arguments

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

5.6.1.4 Transfer

Table 14 shows the Method Transfer arguments.

Signature

```

Transfer (
    [in]  ByteString CommunicationRelationId,
    [in]  UInt16      Command,
    [in]  ByteString Request,
    [out] ByteString Reply,
    [out] Int32       ServiceError);
    
```

Table 14 – 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 which is directly connected to the FDI® Communication Server hardware. The nodeId allows finding the direct parent-child relation.
Command	Command number of the CP 9/1 command to be sent. The FDI® Communication Server is required to generate and send the PDU in the proper format according to CP 9/1 protocol specifications (e.g. taking care of command expansion).
Request	An array of bytes representing the data bytes in the CP 9/1 command request (e.g. starting after the byte count, and ending before the checksum).
Reply	An array of bytes representing the data bytes in the CP 9/1 command response (e.g. starting after the byte count, and ending before the checksum).
ServiceError	0: OK / execution finished -1: Transfer Failed / cancelled 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 Request content -6: Transfer Failed / invalid Reply format
NOTE 1 IEC 62769-7 defines the argument SendData of the Transfer Method as an array of Variant. The arguments Command and Request defined in the table 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 Reply defined in the table is represented as the entry of the Variant array.	

5.6.1.5 GetPublishedData

CP 9/1 burst and event notification messages represent unsolicited messages as defined in IEC 62769-7. Table 15 shows the Method GetPublishedData arguments.

Signature:

```

GetPublishedData (
    [in]  ByteString CommunicationRelationId,
    [out] UInt16      Command,
    [out] ByteString Reply,
    [out] DateTime    TimeStamp,
    [out] Int32       ServiceError);
    
```

Table 15 – 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.
Command	Command number of the CP 9/1 command published. The FDI [®] Communication Server is required to parse the PDU in various formats according to CP 9/1 Protocol standards (e.g. taking care of command expansion).
Reply	An array of bytes representing the data bytes in the published CP 9/1 command response (e.g. starting after the byte count, and ending before the checksum).
TimeStamp	Time at which the published data was captured.
ServiceError	0: OK / execution finished -1: GetPublishedData Failed / cancelled 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 burst / event data published.
NOTE IEC 62769-7 defines the argument ReceiveData of the GetPublishedData Method as an array of Variant. The arguments Command and Reply defined in the table are represented as entries of the Variant array in the order they are specified above.	

5.6.1.6 SetAddress

Table 16 shows the Method SetAddress arguments.

Signature

```

SetAddress (
    [in] UInt8 OldPollAddress,
    [in] UInt8 NewPollAddress,
    [out] Int32 ServiceError);

```

Table 16 – Method SetAddress arguments

Argument	Description
OldPollAddress	The argument value holds the current address of a device. Allowed values are 0..63.
NewPollAddress	The argument value holds the new address for a device. Allowed values are 0..63
ServiceError	0: OK / execution finished successfully -1: SetAddress Failed / cancelled 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
NOTE 1 IEC 62769-7 defines the argument OldAddress of the SetAddress Method as an array of Variant. The argument OldPollAddress defined in the table is represented as the entry of the Variant array.	
NOTE 2 IEC 62769-7 defines the argument NewAddress of the SetAddress Method as an array of Variant. The argument NewPollAddress defined in the table is represented as the entry of the Variant array.	

5.6.1.7 Scan

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

5.6.1.8 ResetScan

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

5.6.2 Methods for Gateways

5.6.2.1 General

The method signatures described in 5.6.2 shall be implemented in the EDD element IEC 62769-4 contained in a Gateway related FDI® Package containing the communication device definitions.

5.6.2.2 Connect

Table 17 shows the Method Connect arguments.

Signature:

```

METHOD BeginConnect(
    DD_String      CommunicationRelationId,
    DD_String      LongAddress,
    unsigned long  ServiceID,
    unsigned long  &DelayForNextCall,
    long           &ServiceError)
{
    DEFINITION {<Gateway specific implementation>}
}

METHOD EndConnect(
    DD_String      CommunicationRelationId,
    unsigned long  ServiceID,
    unsigned long  &DelayForNextCall,
    long           &ServiceError);
{
    DEFINITION {<Gateway specific implementation>}
}

METHOD CancelConnect(
    DD_String      CommunicationRelationId,
    unsigned long  ServiceID,
    long           &ServiceError);
{
    DEFINITION {<Gateway specific implementation>}
}

```

Table 17 – Method Connect arguments

Argument	Description
CommunicationRelationId	The argument value contains the nodeId of the ConnectionPoint representing the connection between a device and a physical network which is directly connected to the FDI [®] Communication Server hardware. The nodeId allows finding the direct parent-child relation.
LongAddress	The argument name shall match with the corresponding attribute name defined for the ConnectionPoint which is described by a corresponding EDD element specified in 5.5.1. The argument holds the devices long (5-byte) address. The value can be obtained by the method Scan.
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.
ServiceError	1: OK / function started asynchronously, result has to be polled with EndConnect 0: OK / execution finished, connection established successfully -1: Connect Failed / cancelled by caller -2: Call Failed / unknown service ID -3: Connect Failed / device not found -4: Connect Failed / invalid device address -5: Connect Failed / invalid device identification

5.6.2.3 Disconnect

Table 18 shows the Method Disconnect arguments.

Signature:

```

METHOD Disconnect (
    DD_String communicationRelationId,
    Long &serviceError)
{
    DEFINITION {<Gateway specific implementation>}
}
    
```

Table 18 – Method Disconnect arguments

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

5.6.2.4 Transfer

Table 19 shows the Method Transfer arguments.

Signature:

```

METHOD BeginTransfer (
    DD_String CommunicationRelationId,
    unsigned short Command,
    DD_String Request,
    DD_String &Reply,
    unsigned long ServiceId,
    unsigned long &DelayForNextCall,
    long &ServiceError);
{
    DEFINITION {<Gateway specific implementation>}
}

METHOD EndTransfer (
    DD_String CommunicationRelationId,
    DD_String &Reply,
    unsigned long ServiceId,
    unsigned long &DelayForNextCall,
    long &ServiceError);
{
    DEFINITION {<Gateway specific implementation>}
}

METHOD CancelTransfer (
    DD_String CommunicationRelationId,
    unsigned long ServiceId,
    long &ServiceError);
{
    DEFINITION {<Gateway specific implementation>}
}
    
```

Table 19 – 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 which is directly connected to the FDI [®] Communication Server hardware. The nodeId allows finding the direct parent-child relation.
Command	Command number of the CP 9/1 command to be sent. The FDI [®] Communication Server is required to generate and send the PDU in the proper format according to CP 9/1 protocol specifications (e.g. taking care of command expansion).
Request	An array of bytes representing the data bytes in the CP 9/1 command request (e.g. starting after the byte count, and ending before the checksum).
Reply	An array of bytes representing the data bytes in the CP 9/1 command response (e.g. starting after the byte count, and ending before the checksum).
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.
ServiceError	<ul style="list-style-type: none"> 1: OK / function started asynchronously, result has to be polled with EndTransfer 0: OK / execution finished -1: Transfer Failed / cancelled 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 REQUEST content -6: Transfer Failed / invalid REPLY format

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5.6.2.5 GetPublishedData

CP 9/1 burst and event notification messages represent unsolicited messages as defined with IEC 62769-7. Table 20 shows the Method GetPublishedData arguments.

Signature

```

METHOD BeginGetPublishedData (
    DD_String      CommunicationRelationId,
    unsigned short &Command,
    DD_String      &Reply,
    TIME           &TimeStamp
    unsigned long  ServiceId,
    unsigned long  &DelayForNextCall,
    long           &ServiceError);
{
    DEFINITION {<Gateway specific implementation>}
}

METHOD EndGetPublishedData (
    DD_String      CommunicationRelationId,
    unsigned short &Command,
    DD_STRING      &Reply,
    TIME           &TimeStamp
    unsigned long  ServiceId,
    unsigned long  &DelayForNextCall,
    long           &ServiceError);
{
    DEFINITION {<Gateway specific implementation>}
}

METHOD CancelGetPublishedData (
    DD_String      CommunicationRelationId,
    unsigned long  ServiceId,
    long           &ServiceError);
{
    DEFINITION {<Gateway specific implementation>}
}
    
```

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Table 20 – 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.
Command	Command number of the CP 9/1 command published. The FDI [®] Communication Server is required to parse the PDU in various formats according to CP 9/1 Protocol standards (e.g. taking care of command expansion).
Reply	An array of bytes representing the data bytes in the published CP 9/1 command response (e.g. starting after the byte count, and ending before the checksum).
TimeStamp	Time at which the published data was captured.
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	1: OK / function started asynchronously, result has to be polled with EndGetPublishedData 0: OK / execution finished -1: GetPublishedData Failed / cancelled 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 burst information published

5.6.2.6 SetAddress

Table 21 shows the Method SetAddress arguments.

Signature

```

METHOD BeginSetAddress (
    unsigned char OldPollAddress,
    unsigned char NewPollAddress,
    unsigned long ServiceId,
    unsigned long &DelayForNextCall,
    long &ServiceError);
{
    DEFINITION {<Gateway specific implementation>}
}

METHOD EndSetAddress (
    unsigned long ServiceId,
    unsigned long &DelayForNextCall,
    long &ServiceError);
{
    DEFINITION {<Gateway specific implementation>}
}

METHOD BeginSetAddress (
    unsigned long ServiceId,
    long &ServiceError);
{
    DEFINITION {<Gateway specific implementation>}
}

```

Table 21 – Method SetAddress arguments

Argument	Description
OldPollAddress	The argument value holds the current address of a device. The allowed values are 0..63.
NewPollAddress	The argument value holds the new address for a device. The allowed values are 0..63.
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.
ServiceError	1: OK / function started asynchronously, result has to be polled with EndSetAddress 0: OK / execution finished successfully -1: SetAddress Failed / cancelled 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

5.6.2.7 Scan

The method signature specified in IEC 62769-7 applies. The HART Gateway business logic shall create the scan result using the following EDD definitions, which shall be included in the communication device COMPONENT definition. The EDD LIST also held in the COMPONENT holds the list of devices corresponding to the data structure defined in the XML schema. This LIST shall be referred to by the SCAN_LIST attribute of the communication device component. The corresponding topologyScanResult schema is specified in Annex A.

```
VARIABLE DevAddr
{
    LABEL "Address";
    CLASS DEVICE;
    TYPE UNSIGNED_INTEGER(5);
    HANDLING READ & WRITE;
}
```

```
VARIABLE DevMfg
{
    LABEL "Manufacturer";
    CLASS DEVICE;
    TYPE UNSIGNED_INTEGER(2);
    HANDLING READ & WRITE;
}
```

```
VARIABLE DevType
{
  LABEL "Device Type";
  CLASS DEVICE;
  TYPE UNSIGNED_INTEGER(2);
  HANDLING READ & WRITE;
}

VARIABLE DevRev
{
  LABEL "Device Revision";
  CLASS DEVICE;
  TYPE UNSIGNED_INTEGER;
  HANDLING READ & WRITE;
}

VARIABLE DevTag
{
  LABEL "Tag";
  CLASS DEVICE;
  TYPE ASCII(32);
  HANDLING READ & WRITE;
}

COLLECTION ScanItemType_TP
{
  MEMBERS
  {
    ADDRESS, DevAddr;
  }
}

COLLECTION DeviceIdentificationType
{
  MEMBERS
  {
    MFG,          DevMfg;
    DEV_TYPE,    DevType;
    DEV_REV,     DevRev;
    TAG,         DevTag;
  }
}

COLLECTION ScanResultType
{
  MEMBERS
  {
    ScanItem,          ScanItemType_TP;
    DeviceIdentification, DeviceIdentificationType;
  }
}

LIST TopologyScanResult
{
  TYPE ScanResultType;
  CAPACITY 64; //Defined to limitation of the comm. device
}
```

5.6.2.8 ScanNext

The method signature specified in IEC 62769-7 applies. The HART Gateway business logic shall create the scan result using the same EDD definitions defined in 5.6.2.7. The corresponding topologyScanResult schema is specified in Annex A.

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Annex A (normative)

Topology scan schema

A.1 General

The Topology scan result schema specified in Annex A describes the HART 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 IdentificationType

The element content corresponds to the "FunctionalGroup Identification".

The XML schema for IdentificationType is:

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```

<xs:complexType name="IdentificationT">
  <xs:attribute name="MANUFACTURER_ID" type="xs:unsignedShort"
use="required">
  </xs:attribute>
  <xs:attribute name="DEVICE_TYPE" type="xs:unsignedShort"
use="required">
  </xs:attribute>
  <xs:attribute name="UNIVERSAL_REVISION" type="xs:unsignedByte"
use="required">
  </xs:attribute>
  <xs:attribute name="DEVICE_REVISION" type="xs:unsignedByte"
use="required">
  </xs:attribute>
  <xs:attribute name="SERIAL_NUMBER" use="required">
  <xs:simpleType>
    <xs:restriction base="xs:unsignedInt">
      <xs:minInclusive value="0"/>
      <xs:maxInclusive value="16777215"/>
    </xs:restriction>
  </xs:simpleType>
</xs:attribute>
  <xs:attribute name="HARDWARE_REVISION" use="required">
  <xs:simpleType>
    <xs:restriction base="xs:unsignedByte">
      <xs:minInclusive value="0"/>
      <xs:maxInclusive value="31"/>
    </xs:restriction>
  </xs:simpleType>
</xs:attribute>
  <xs:attribute name="SOFTWARE_REVISION" type="xs:unsignedByte"
use="required">
  </xs:attribute>
  <xs:attribute name="REV_COUNTER" type="xs:unsignedShort"
default="0">
  </xs:attribute>
  <xs:attribute name="TAG" use="required">
  <xs:simpleType>
    <xs:restriction base="xs:string">
      <xs:maxLength value="32"/>
    </xs:restriction>
  </xs:simpleType>
</xs:attribute>
</xs:complexType>

```

The attributes of IdentificationType are described in Table A.1.

Table A.1 – Attributes of IdentificationT

Attribute	Description
MANUFACTURER_ID	<p>Manufacturer identification number.</p> <p>For HART universal revision 7 or higher devices: 2-byte manufacturer code of a device, returned in bytes 17 and 18 of Command 0 or Command 11 or Command 21.</p> <p>For HART revision 6 or lower devices: Most significant byte shall be fixed to 0, and the least significant byte is returned in byte 1 of Command 0 or Command 11 or Command 21</p>
DEVICE_TYPE	<p>Manufacturer's model number associated with the resource.</p> <p>For HART universal revision 7 or higher devices: 2 byte device type returned in bytes 1 and 2 of Command 0 or Command 11 or Command 21</p> <p>For HART revision 6 or lower devices: Most significant byte shall be fixed to 0, and the least significant byte is returned in byte 2 of Command 0 or Command 11 or Command 21</p>
UNIVERSAL_REVISION	<p>Universal HART revision associated with the device. Returned in byte 4 of Command 0 or Command 11 or Command 21</p>
DEVICE_REVISION	<p>Manufacturer's device revision number associated with the device. Returned in byte 5 of Command 0 or Command 11 or Command 21</p>
SERIAL_NUMBER	<p>Unique serial number of the device. 3-byte unique ID of a device, returned in bytes 9 to 11 of Command 0 or Command 11 or Command 21</p>
HARDWARE_REVISION	<p>Manufacturer hardware revision associated with the device. Returned in byte 7 (only 5 most significant bits) of Command 0 or Command 11 or Command 21</p>
SOFTWARE_REVISION	<p>Manufacturer firmware revision associated with the device. Returned in byte 6 of Command 0 or Command 11 or Command 21</p>
REV_COUNTER	<p>The configuration change counter associated with the device.</p> <p>For HART universal revision 6 or higher devices: Returned in bytes 14 and 15 of Command 0 or Command 11 or Command 21.</p> <p>For HART revision 5 or lower devices: -1 (not defined).</p>
TAG	<p>The configured Identification tag associated with the device.</p> <p>For HART universal revision 6 or higher devices: 32 character long tag returned in Command 20 or Command 21.</p> <p>For HART revision 5 or lower devices: 8 character tag returned in Command 11 or Command 13.</p>

A.3 AddressTypeTP

The XML schema for AddressTypeTP is:

```
<xs:complexType name="AddressTypeTP">  
  <xs:complexContent>  
    <xs:extension base="hart:LongAddressT">  
      <xs:sequence>  
        <xs:element name="DevPollAddr" minOccurs="0">  
          <xs:simpleType>  
            <xs:restriction base="xs:unsignedByte">  
              <xs:minInclusive value="0"/>  
              <xs:maxInclusive value="63"/>  
            </xs:restriction>  
          </xs:simpleType>  
        </xs:element>  
      </xs:sequence>  
    </xs:extension>  
  </xs:complexContent>  
</xs:complexType>
```

The elements of AddressTypeTP are described in Table A.2.

Table A.2 – Elements of AddressTypeTP

Element	Description
DevAddr	Holds the 5-byte HART address of the associated device.
DevPollAddr	Holds the HART short address used for polling the associated device.

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The elements of AddressTypeTDMA are described in Table A.4.

Table A.4 – Elements of AddressTypeTDMA

Element	Description
DevAddr	Holds the 5-byte HART address of the associated device.
IPAddress	Holds the network IP address of the associated device.
IPVersion	Holds the IP version number used for the associated device (either version 4 or 6).
IPPort	Holds the IP Port number used for the associated device.

A.6 AddressType

The XML schema for AddressType is:

```

<xs:complexType name="AddressT">
  <xs:choice>
    <xs:element name="AddressTP" type="hart:AddressTypeTP">
    </xs:element>
    <xs:element name="AddressIP" type="hart:AddressTypeIP">
    </xs:element>
    <xs:element name="AddressTDMA" type="hart:AddressTypeTDMA">
    </xs:element>
  </xs:choice>
</xs:complexType>

<xs:complexType name="LongAddressT">
  <xs:sequence>
    <xs:element name="DevAddr">
      <xs:simpleType>
        <xs:restriction base="xs:string">
          <xs:pattern value="([A-Fa-f0-9]{10})"/>
        </xs:restriction>
      </xs:simpleType>
    </xs:element>
  </xs:sequence>
</xs:complexType>

```

The elements of AddressType are described in Table A.5.

Table A.5 – Elements of AddressT

Element	Description
AddressTP	Token passing addresses hold the address information used for ConnectionPointType_HART_TP5, 6, or 7 described in 5.5.1.2.
AddressIP	IP addresses hold the address information described in ConnectionPointType_HART_IP described in 5.5.1.2.
AddressTDMA	TDMA addresses hold the address information described in ConnectionPointType_HART_TDMA described in 5.5.1.2.

A.7 ConnectionPointType

The XML schema for ConnectionPointType is:

```
<xs:complexType name="ConnectionPointT">
  <xs:sequence>
    <xs:element name="Identification" type="hart:IdentificationT">
      </xs:element>
    <xs:element name="Address" type="hart:AddressT">
      </xs:element>
    </xs:sequence>
  </xs:complexType>
```

The elements of a ConnectionPointType are described in Table A.6.

Table A.6 – Elements of ConnectionPointT

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.
Address	The address element holds the specific information used to uniquely address the device in the network. The address will be one of three possible types described by AddressType.

A.8 NetworkType

The element type describes the complete scan result for a single network because of the scan method that is provided per instance of a "Communication Device" which exists in a 1:1 relation to a network instance.

The XML schema for a NetworkType is:

```
<xs:complexType name="NetworkT">
  <xs:sequence>
    <xs:element name="ConnectionPoint" type="hart:ConnectionPointT"
      maxOccurs="unbounded">
      </xs:element>
    </xs:sequence>
  </xs:complexType>
```

The elements of a NetworkType are described in Table A.7.

Table A.7 – Elements of NetworkT

Element	Description
ConnectionPoint	The ConnectionPoint element holds the address and identification of the network connected device that has been found during bus scan operations.

A.9 Network

The subsequent element hierarchy is used to return the scan result according to the Information Model (IEC 62769-5) representation of a topology.

The XML schema for a Network element is:

```
<xs:element name="Network" type="hart:NetworkT">  
</xs:element>
```

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Annex B (normative)

Transfer service parameters

B.1 General

Direct Access Services specified in IEC 62769-2 enable the User Interface Plug-in (UIP) to directly exchange data with the device. Direct data exchange means that data exchanged between a device and a UIP may not be reflected in the Information Model. The IEC 62769-6 defined interface IDirectAccess corresponds to the IEC 62769-2 specified Direct Access Services. Interface IDirectAccess defined functions BeginTransfer and EndTransfer need to convey protocol specific information. The following XML schema documents the protocol specifics.

B.2 receiveData

The element described in the following contains data that is returned through IDirectAccess function Endtransfer and GetPublishedData defined return value.

```
<xs:element name="receiveData" type="hart:TransferResultDataT">
</xs:element>
```

B.3 sendData

The element described in the following contains data to be submitted through IDirectAccess function Begintransfer defined argument sendData.

```
<xs:element name="sendData" type="hart:TransferSendDataT">
</xs:element>
```

B.4 TransferResultDataT

The XML element type defines the service parameter data format that shall be applied to the EndTransfer and GetPublishedData defined return value. The attribute names defined in TransferResultDataType correspond to same name of Transfer method arguments specified in 5.6.1.4 and 5.6.2.4.

```
<xs:complexType name="TransferResultDataT">
  <xs:attribute name="COMMAND" type="xs:unsignedInt"
use="required">
  </xs:attribute>
  <xs:attribute name="REPLY" type="xs:hexBinary" use="required">
  </xs:attribute>
</xs:complexType>
```

Table B.1 defines the attributes of TransferResultDataT.

Table B.1 – Attributes of TransferResultDataT

Attribute	Description
COMMAND	The attribute corresponds to the CP9/1 command number.
REPLY	The attribute corresponds to the REPLY data bytes in the CP9/1 command data field.

B.5 TransferSendDataT

The XML element type defines the service parameter data format that shall be applied to BeginTransfer defined argument sendData. The attribute names defined in TransferSendDataType correspond to the same name of Transfer method arguments specified in 5.6.1.4 and 5.6.2.4.

```
<xs:complexType name="TransferSendDataT">  
  <xs:attribute name="COMMAND" type="xs:unsignedInt"  
use="required">  
  </xs:attribute>  
  <xs:attribute name="REQUEST" type="xs:hexBinary" use="required">  
  </xs:attribute>  
</xs:complexType>
```

Table B.2 defines the attributes of TransferSendDataT

Table B.2 – Attributes of TransferSendDataT

Attribute	Description
COMMAND	The attribute corresponds to the CP9/1 command number.
REQUEST	The attribute corresponds to the REQUEST data bytes in the CP9/1 command data field.

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Annex C (informative)

Mapping to PA DIM

C.1 General

IEC 62769-8 specifies how the internal view of a device model represented by the EDD can be transferred into an external view as an OPC-UA information model by mapping EDD constructs to OPC-UA objects. This Annex C gives an overview on the mapping of standard parameters defined in HART to PA DIM.

C.2 Mapping Table

Table C.1 specifies the parameters, for which a direct mapping exists. Other parameters such as the AssetId cannot be mapped directly. In these cases manufacturer specific variables might be used.

Table C.1 – Mapping from HART standard parameters to PA DIM

Usage	PA-DIM BrowsePath	IEC 61987 CDD	Mappable HART Standard Parameters
Identification	ProductInstanceUri	0112/2///61987#ABN590#001	--
Identification	Manufacturer	0112/2///61987#ABA565#007	manufacturer_id
Identification	ProductCode	0112/2///61987#ABA300#006	--
Identification	Model	0112/2///61987#ABA567#007	device_type
Identification	SerialNumber	0112/2///61987#ABA951#007	--
Identification	HardwareRevision	0112/2///61987#ABA926#006	hardware_revision
Identification	SoftwareRevision	0112/2///61987#ABA601#006	software_revision
Identification	RevisionCounter	0112/2///61987#ABN603#001	config_change_counter
AssetId (User Tag of Device)	AssetId	0112/2///61987#ABA038#003	longTag
DeviceHealth	DeviceHealth	0112/2///61987#ABN972#001	--

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⁴ To be published.

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SOMMAIRE

AVANT-PROPOS	48
1 Domaine d'application	50
2 Références normatives	50
3 Termes, définitions, abréviations et acronymes	50
3.1 Termes et définitions	50
3.2 Abréviations et acronymes	51
4 Conventions	51
4.1 Syntaxe EDDL	51
4.2 Syntaxe XML	51
4.3 Utilisation de majuscules	51
5 Profil pour CP 9/1 (HART®) ou CP 9/2 (WirelessHART®).....	52
5.1 Généralités	52
5.2 Profil de catalogue	52
5.2.1 Fichier de prise en charge de protocole	52
5.2.2 Définition du CommunicationProfile	53
5.2.3 Appareil de profil	53
5.2.4 Informations relatives à la version du protocole	53
5.3 Association d'un Paquetage à un appareil CP 9/1	54
5.3.1 Mapping d'identification du type d'appareil	54
5.3.2 Mapping de révision de type d'appareil	54
5.4 Mapping du Modèle d'information.....	54
5.4.1 Définition du ProtocolType	54
5.4.2 Mapping de DeviceType	55
5.4.3 Définition du FunctionalGroup "Identification"	55
5.5 Eléments de topologie	56
5.5.1 Définition du ConnectionPoint.....	56
5.5.2 Définition de l'appareil de communication	62
5.5.3 Définition du fournisseur de service de communication	63
5.5.4 Définition du Réseau	64
5.6 Méthodes	65
5.6.1 Méthodes pour les Serveurs de communication FDI®	65
5.6.2 Méthodes pour les Passerelles	69
Annexe A (normative) Schéma de balayage de la topologie	78
A.1 Généralités	78
A.2 IdentificationType	78
A.3 AddressTypeTP	81
A.4 AddressTypeIP	82
A.5 AddressTypeTDMA	82
A.6 AddressType	83
A.7 ConnectionPointType	84
A.8 NetworkType	84
A.9 Network	85
Annexe B (normative) Paramètres du service Transfer	86
B.1 Généralités	86
B.2 receiveData	86
B.3 sendData	86

B.4	TransferResultDataT.....	86
B.5	TransferSendDataT.....	87
Annexe C (informative) Mapping avec le PA DIM		88
C.1	Généralités	88
C.2	Table de mapping	88
Bibliographie.....		89
Tableau 1 – Fichiers d'informations appareil		52
Tableau 2 – Définition du CommunicationProfile		53
Tableau 3 – Valeurs de catalogue pour les appareils de profil.....		53
Tableau 4 – Informations relatives à la Version du protocole.....		54
Tableau 5 – Mapping dans le catalogue des types d'appareils		54
Tableau 6 – Définition du ProtocolType HART		55
Tableau 7 – Mapping des propriétés héritées du DeviceType.....		55
Tableau 8 – Paramètres d'identification		56
Tableau 9 – Définition du ConnectionPointType HART_TP		57
Tableau 10 – Définition du ConnectionPointType HART_IP.....		59
Tableau 11 – Définition du ConnectionPointType HART_TDMA		61
Tableau 12 – Arguments de la méthode Connect.....		66
Tableau 13 – Arguments de la méthode Disconnect.....		66
Tableau 14 – Arguments de la méthode Transfer.....		67
Tableau 15 – Arguments de la méthode GetPublishedData.....		68
Tableau 16 – Arguments de la méthode SetAddress.....		69
Tableau 17 – Arguments de la méthode Connect.....		70
Tableau 18 – Arguments de la méthode Disconnect.....		71
Tableau 19 – Arguments de la méthode Transfer.....		72
Tableau 20 – Arguments de la méthode GetPublishedData.....		74
Tableau 21 – Arguments de la méthode SetAddress		75
Tableau A.1 – Attributs de IdentificationT.....		80
Tableau A.2 – Eléments d'AddressTypeTP		81
Tableau A.3 – Eléments de AddressTypeIP		82
Tableau A.4 – Eléments de AddressTypeTDMA		83
Tableau A.5 – Eléments d'AddressT		83
Tableau A.6 – Eléments de ConnectionPointT		84
Tableau A.7 – Eléments de NetworkT		84
Tableau B.1 – Attributs de TransferResultDataT		86
Tableau B.2 – Attributs de TransferSendDataT		87
Tableau C.1 – Mapping des paramètres normalisés HART avec le PA DIM.....		88

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

INTÉGRATION DES APPAREILS DE TERRAIN (FDI®) –

Partie 109-1: Profils – HART® et WirelessHART®

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Cette troisième édition annule et remplace la deuxième édition parue en 2020. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) ajout du type de contenu pour les fichiers DeviceInfo;
- b) ajout du mapping des paramètres normalisés HART avec le PA DIM (*Process Automation Device Information Model*).

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
65E/864/CDV	65E/921/RVC

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

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INTÉGRATION DES APPAREILS DE TERRAIN (FDI®) –

Partie 109-1: Profils – HART® et WirelessHART®

1 Domaine d'application

La présente partie de l'IEC 62769 spécifie un profil FDI¹ de l'IEC 62769 pour les profils de communication CP 9/1 (HART[®])² et CP 9/2 (WirelessHART[®])³ définis dans l'IEC 61784-1.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 62541-100, *Architecture unifiée OPC – Partie 100: Interface d'appareils*

IEC 62769-4, *Intégration des appareils de terrain (FDI®) – Partie 4: Paquetages FDI®*

IEC 62769-5, *Intégration des appareils de terrain (FDI®) – Partie 5: Modèle d'information*

IEC 62769-7, *Intégration des appareils de terrain (FDI®) – Partie 7: Appareils de communication*

3 Termes, définitions, abréviations et acronymes

3.1 Termes et définitions

Pour les besoins du présent document, les termes et les définitions de l'IEC 62541-100, l'IEC 62769-4, l'IEC 62769-5 et l'IEC 62769-7 s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse <http://www.electropedia.org/>
- ISO Online browsing platform: disponible à l'adresse <http://www.iso.org/obp>

¹ FDI est une marque déposée de l'organisation à but non lucratif Fieldbus Foundation, Inc. Cette information est donnée à l'intention des utilisateurs du présent document et ne signifie nullement que l'IEC approuve le détenteur de la marque ou l'emploi de ses produits. La conformité n'exige pas l'utilisation de la marque. L'utilisation de la marque exige l'autorisation du détenteur de la marque.

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3.2 Abréviations et acronymes

Pour les besoins du présent document, les abréviations et acronymes suivants s'appliquent:

CP (Communication Profile)	Profil de communication (voir l'IEC 61784-1 ou l'IEC 61784-2)
CPF (Communication Profile Family)	Famille de profils de communication (voir l'IEC 61784-1 ou l'IEC 61784-2)
EDD (Electronic Device Description)	Description électronique de produit (voir la série IEC 61804)
EDDL (Electronic Device Description Language)	Langage de description électronique de produit (voir la série IEC 61804)
FDI® (Field Device Integration)	Intégration des appareils de terrain
FSK (Frequency-Shift-Keying)	Modulation par déplacement de fréquence
HCF	HART Communication Foundation
ID	Identification
IM (Information Model)	Modèle d'information
IP (Internet Protocol)	Protocole Internet
PDU (Protocol Data Unit)	Unité de données de protocole
PSK (Phase-Shift-Keying)	Modulation par déplacement de phase
TCP (Transmission Control Protocol)	Protocole de commande de transmission (voir le RFC 793 de l'IETF)
UDP (User Datagram Protocol)	Protocole datagramme d'utilisateur (voir le RFC 768 de l'IETF)
XML (Extended markup language)	Langage de balisage étendu

4 Conventions

4.1 Syntaxe EDDL

Le présent document spécifie le contenu du composant EDD qui fait partie des Paquetages de communication FDI®. La syntaxe EDDL utilise la police Courier New. La syntaxe EDDL est utilisée pour les déclarations de signature de méthode, de variable, de structure de données et de composant.

4.2 Syntaxe XML

Les exemples de syntaxe XML utilisent la police Courier New. La syntaxe XML est utilisée pour décrire le schéma des documents XML.

Exemple: `<xs:simpleType name="ExampleT">`

4.3 Utilisation de majuscules

La série IEC 62769 utilise des termes en majuscules pour souligner que ces termes ont une signification spécifique de la FDI®.

Certains de ces termes utilisent un acronyme comme suffixe, par exemple:

- Client FDI®; ou
- Serveur FDI®.

Certains de ces termes sont des termes composés, par exemple:

- Serveurs de communication FDI®; ou
- Paquetage de profil.

Les noms de paramètres ou attributs sont concaténés en un seul et même terme, où les termes d'origine composant ce terme commencent par une lettre majuscule. Par exemple:

- ProtocolSupportFile; ou
- ProtocolType.

Les noms de paramètres ou attributs peuvent également être combinés au moyen d'un trait de soulignement afin de concaténer deux ou plusieurs termes. Par exemple:

- PROFILE_ID; ou
- HART_Network.

5 Profil pour CP 9/1 (HART®) ou CP 9/2 (WirelessHART®)

5.1 Généralités

Le présent document de profil, lié à la spécification FDI® de l'IEC 62769, choisit les éléments spécifiques du protocole nécessaires aux Paquetages FDI® qui décrivent les Serveurs de communication, les Passerelles et les Appareils.

L'Annexe B définit le schéma XML des Services d'accès direct. L'Annexe C fournit une vue d'ensemble du mapping des paramètres normalisés PROFIBUS avec le PA DIM.

5.2 Profil de catalogue

5.2.1 Fichier de prise en charge de protocole

Les fichiers d'informations appareil fournissent des métadonnées relatives aux données dynamiques d'exécution fournies par l'appareil. Ces métadonnées sont un sous-ensemble d'informations contenues dans l'EDD. Les fichiers d'informations appareil peuvent être extraits du paquetage par des mises en œuvre de serveur léger ou de passerelle légère, dans l'objectif d'échanger des informations d'exécution appareil avec un traitement minimal des mises en œuvre. Les fichiers d'informations appareil ne sauraient se substituer à la nécessité d'une partie EDD, car ils ne contiennent qu'un sous-ensemble d'informations de l'EDD et ne fournissent pas d'éléments sur l'interface utilisateur.

Les formats des Fichiers d'informations appareil sont décrits dans le Tableau 1.

Tableau 1 – Fichiers d'informations appareil

Partie	Contenu
Type de contenu	application/vnd.hart.json
Root Namespace (Espace de noms racine)	Non spécifié ici
Relation source	http://fdi-cooperation.com/2010/relationships/attachment-protocol
Nom de fichier	Non spécifié ici

Les Fichiers d'informations appareil sont spécifiés dans la spécification FCG AG21073.

5.2.2 Définition du CommunicationProfile

L'IEC 62769-4 définit une chaîne CommunicationProfileT pour le schéma XML Catalog. Le Tableau 2 définit les valeurs spécifiques du CP 9/1 pour cette énumération.

Tableau 2 – Définition du CommunicationProfile

CommunicationProfile	Description
hart_fsk	Type d'appareil CP 9/1 qui prend en charge une couche physique FSK (modulation par déplacement de fréquence sur une paire de fils).
hart_psk	Type d'appareil CP 9/1 qui prend en charge une couche physique PSK (modulation par déplacement de phase sur une paire de fils). Les appareils qui prennent en charge la modulation PSK doivent également prendre intrinsèquement en charge la modulation FSK. Par conséquent, la PSK est toujours utilisée uniquement en combinaison avec au moins la FSK.
hart_wirelesshart	Type d'appareil CP 9/2 qui prend en charge une couche physique sans fil (communication entre appareil et passerelle).
hart_ip	Type d'appareil CP 9/1 qui prend en charge le Protocole Internet (ces appareils prennent en charge les protocoles TCP et UDP).
hart_rs485	Type d'appareil CP 9/1 qui prend en charge la communication numérique EIA-485.
hart_ir	Type d'appareil CP 9/1 qui prend en charge une Couche physique infrarouge (conçue pour être transparente aux maîtres FSK – incluse uniquement à titre d'information pour indiquer que l'appareil prend en charge la connexion infrarouge).
NOTE Un même appareil CP 9/1 peut prendre en charge plus d'un CP.	

5.2.3 Appareil de profil

Un Paquetage de Profil doit fournir les valeurs de catalogue des appareils de profil en permettant au Serveur FDI® d'optimiser la description d'appareil générique, si une description spécifique n'est pas disponible. Les définitions du Tableau 3 portent sur le contenu du catalogue qui est indépendant du fournisseur.

Tableau 3 – Valeurs de catalogue pour les appareils de profil

Elément	Attribut	Contenu
PackageType	—	Profil
DeviceModel	—	Vide
Manufacturer	—	Vide

5.2.4 Informations relatives à la version du protocole

L'IEC 62769-4 définit un type d'élément nommé InterfaceT pour le schéma XML Catalog. Le type d'élément InterfaceT contient un élément nommé Version qui a pour objet de fournir des informations de version relatives au profil de protocole de communication appliqué. La valeur doit respecter le schéma d'informations de version de l'IEC 62769-4 défini dans le type d'élément VersionT. Le 5.2.4 décrit comment appliquer les versions de protocole actuellement connues pour les entrées CP 9/1 ou CP 9/2 du catalogue d'appareils. La règle générale consiste à utiliser la Révision Universelle du protocole pour la partie version majeure de VersionT et la valeur "0" pour les parties version mineure et numéro de compilation (build). Le Tableau 4 donne les informations relatives à la Version du protocole.

Tableau 4 – Informations relatives à la Version du protocole

Version de protocole	Valeur de version InterfaceT
Révision Universelle HART 5	5.0.0
Révision Universelle HART 6	6.0.0
Révision Universelle HART 7	7.0.0
La Version de protocole définie dans un paquetage est fournie à titre d'information seulement; elle ne doit pas être utilisée pour déterminer la compatibilité ou l'applicabilité d'un paquetage à un appareil.	

5.3 Association d'un Paquetage à un appareil CP 9/1

5.3.1 Mapping d'identification du type d'appareil

Les types d'appareils CP 9/1 sont identifiés de façon univoque par les paramètres Manufacturer, Model et DeviceRevision. Ces paramètres sont utilisés pour associer une instance d'appareil donnée à un Paquetage d'Appareil FDI®. Ces paramètres sont mappés avec le Catalogue de Paquetage d'Appareil FDI® conformément au Tableau 5.

Tableau 5 – Mapping dans le catalogue des types d'appareils

Élément Catalog	Mapping des types d'appareils CP (voir Tableau A.1)
Élément Manufacturer d'InterfaceT (IEC 62769-4:2023, Article E.11)	Manufacturer Format de chaîne "0xdddd", où dddd est le MANUFACTURER_ID au format hexadécimal.
Élément DeviceModel d'InterfaceT (IEC 62769-4:2023, Article E.11)	Model Format de chaîne "0xdddd", où dddd est le DEVICE_TYPE au format hexadécimal.
Élément DeviceRevision ListOfSupportedDeviceRevisionsT (IEC 62769-4:2023, Article E.20)	DeviceRevision Format de chaîne "x.0.0", où x est la DEVICE_REVISION au format décimal (pas de zéro de tête).

5.3.2 Mapping de révision de type d'appareil

Chaque type d'appareil est identifié conformément à 5.3.1. Si un paquetage avec une DeviceRevision concordante n'est pas disponible, un quelconque Paquetage FDI® CP 9/1 pour un fabricant et un modèle qui correspondent doit toujours être compatible avec un appareil de terrain tant que la révision d'appareil relative à l'appareil de terrain est supérieure ou égale à la révision d'appareil spécifiée dans le Paquetage FDI®.

5.4 Mapping du Modèle d'information

5.4.1 Définition du ProtocolType

Le Tableau 6 définit le ProtocolType utilisé pour identifier des communications réseau CP 9/1.

Tableau 6 – Définition du ProtocolType HART

Attribut	Valeur				
BrowseName	HART				
IsAbstract	False				
Références	NodeClass	BrowseName	Data Type	TypeDefinition	ModellingRule
Hérite des propriétés du ProtocolType définies dans l'IEC 62541-100					

5.4.2 Mapping de DeviceType

Chaque type d'appareil hérite des propriétés du DeviceType. Le mapping des propriétés héritées du DeviceType est défini dans le Tableau 7.

Tableau 7 – Mapping des propriétés héritées du DeviceType

Propriété	Mapping Foundation
SerialNumber	ID unique d'un appareil, mappé avec l'attribut SERIAL_NUMBER d'IdentificationT
RevisionCounter	Compteur de changement de configuration, mappé avec l'attribut REV_COUNTER d'IdentificationT
Manufacturer	Chaîne issue du Catalogue de Paquetage FDI® (ManufacturerName issu de PackageT)
Model	Chaîne issue du Catalogue de Paquetage FDI® (Name de DeviceTypeT, qui est un nom localisé)
DeviceManual	Chaîne textuelle d'entrée (non prise en charge) ^a
DeviceRevision	Niveau de révision d'un appareil, mappé avec l'attribut DEVICE_REVISION d'IdentificationT
SoftwareRevision	Niveau de révision de logiciel d'un appareil, mappé avec l'attribut SOFTWARE_REVISION d'IdentificationT
HardwareRevision	Niveau de révision de matériel d'un appareil, mappé avec l'attribut HARDWARE_REVISION d'IdentificationT
^a Les manuels de l'appareil sont présentés sous forme de pièces jointes du Paquetage d'Appareil FDI®.	

5.4.3 Définition du FunctionalGroup "Identification"

Comme cela est défini dans l'IEC 62541-100, chaque représentation d'appareil dans le Modèle d'information hébergé sur le Serveur FDI® doit contenir un FunctionalGroup spécifique d'un protocole, appelé "Identification". Ce FunctionalGroup organise les variables qui se trouvent dans l'instance de type d'appareil. Le FunctionalGroup "Identification" pour le CP 9/1 est défini dans le Tableau 8.

Tableau 8 – Paramètres d'identification

BrowseName	Data Type	Facultatif/Obligatoire
MANUFACTURER_ID	UInt16	Obligatoire
DEVICE_TYPE	UInt16	Obligatoire
DEVICE_REVISION	UInt8	Obligatoire
UNIVERSAL_REVISION	UInt8	Facultatif
SERIAL_NUMBER	UInt24	Facultatif
HARDWARE_REVISION	UInt8	Facultatif
SOFTWARE_REVISION	UInt8	Facultatif
REVISION_COUNTER	UInt16	Facultatif

5.5 Eléments de topologie

5.5.1 Définition du ConnectionPoint

5.5.1.1 Généralités

Les appareils CP 9/1 peuvent prendre en charge jusqu'à cinq types de ConnectionPoints qui sont utilisés pour les communications réseau.

5.5.1.2 HART_TP5, HART_TP6, HART_TP7

Les ConnectionPoints de types HART_TP5, HART_TP6 et HART_TP7 doivent être utilisés pour identifier la communication de réseau avec passage de jeton CP 9/1; ils sont définis dans le Tableau 9. Les types HART_TP5, HART_TP6 et HART_TP7 contiennent tous les mêmes propriétés, mais chacun d'eux fournit des informations de qualification différentes pour certaines des propriétés (décrites ci-dessous). La Version de protocole (UNIVERSAL_REVISION) décrite en 5.2.3 peut être utilisée comme aide pour déterminer lequel des trois types de Points de connexion avec passage de jeton est le plus approprié. Les communications avec passage de jeton CP 9/1 peuvent être utilisées sur une diversité de couches physiques. Les connexions de couche physique FSK, PSK, RS485 et infrarouges doivent toutes utiliser le type de connexion HART_TP. Les ConnectionPoints de types HART_TP5, HART_TP6 et HART_TP7 sont des sous-types du type abstrait ConnectionPointType défini dans l'IEC 62769-5.

La propriété DevAddr doit correspondre à l'adresse longue (5 octets) de l'appareil. En outre, elle est le seul paramètre nécessaire pour communiquer avec l'appareil de terrain.

La propriété DevMfg doit correspondre à l'ID fabricant de 2 octets; elle peut être utilisée pour favoriser l'automatisation du processus d'attribution des appareils actifs de la liste de balayage aux espaces réservés hors ligne.

La propriété DevType doit correspondre au type étendu d'appareil de 2 octets; elle peut être utilisée pour favoriser l'automatisation du processus d'attribution des appareils actifs de la liste de balayage aux espaces réservés hors ligne.

La propriété DevRev doit correspondre à la révision d'appareil; elle peut être utilisée pour favoriser l'automatisation du processus d'attribution des appareils actifs de la liste de balayage aux espaces réservés hors ligne.

La propriété DevTag doit correspondre au marqueur long pour les appareils de la version de protocole HART® 6 ou 7. La propriété DevTag doit correspondre au marqueur pour les appareils de la version de protocole 5. La propriété DevTag peut être utilisée pour favoriser l'automatisation du processus d'attribution des appareils actifs de la liste de balayage aux espaces réservés hors ligne. Les Points de connexion HART_TP5 doivent limiter à 8 caractères

la longueur de DevTag. Les Points de connexion HART_TP6 et HART_TP7 doivent limiter à 32 caractères la longueur de DevTag.

La propriété DevPollAddr doit être l'adresse d'interrogation. Par ailleurs, elle peut être utilisée pour identifier quel appareil est localisé à une adresse d'interrogation spécifique. Les Points de connexion HART_TP5 doivent être limités à des valeurs comprises entre 0 et 15 pour la propriété DevPollAddr. Les Points de connexion HART_TP6 doivent être limités à des valeurs comprises entre 0 et 31 pour la propriété DevPollAddr. Les Points de connexion HART_TP7 doivent être limités à des valeurs comprises entre 0 et 63 pour la propriété DevPollAddr.

Pour la rétrocompatibilité, un Point de connexion HART_TP de révision inférieure est compatible et peut être utilisé pour la connexion d'un appareil relevant d'une révision universelle supérieure. Par exemple, si un appareil d'une future révision universelle HART 8 est rencontré et qu'aucun point de connexion HART_TP8 n'est disponible dans le Serveur FDI®, le point de connexion HART_TP7 est compatible et doit être utilisé pour se connecter à l'appareil. Si la Version de protocole (c'est-à-dire la Révision universelle) est inconnue pour une raison quelconque, le Point de connexion HART_TP5 peut être utilisé et est rétrocompatible avec les révisions universelles ultérieures.

Tableau 9 – Définition du ConnectionPointType HART_TP

Attribut	Valeur				
BrowseName	ConnectionPoint_HART_TP5 ou ConnectionPoint_HART_TP6 ou ConnectionPoint_HART_TP7				
IsAbstract	False				
Références	NodeClass	BrowseName	Data Type	TypeDefinition	ModellingRule
Hérite des propriétés de ConnectionPointType défini dans l'IEC 62769-5					
HasProperty	Variable	DevAddr	UInt40	PropertyType	Obligatoire
HasProperty	Variable	DevMfg	UInt16	PropertyType	Facultatif
HasProperty	Variable	DevType	UInt16	PropertyType	Facultatif
HasProperty	Variable	DevRev	UInt16	PropertyType	Facultatif
HasProperty	Variable	DevTag	String	PropertyType	Facultatif
HasProperty	Variable	DevPollAddr	UInt8	PropertyType	Facultatif

Les ConnectionPoints de types HART_TP5, HART_TP6 et HART_TP7 doivent être décrits par un élément EDD contenu dans le Paquetage FDI® associé à un Appareil de communication, qui peut piloter un réseau CP 9/1. Les propriétés réelles de ConnectionPoint sont déclarées par les constructions VARIABLE regroupées dans une COLLECTION nommée ConnectionPoint_HART_TP5, ConnectionPoint_HART_TP6 ou ConnectionPoint_HART_TP7. Le code source EDDL ci-après est un exemple qui décrit un Point de connexion TP5.

```
COMPONENT ConnectionPoint_HART_TP5
{
  LABEL "HART TP Connection Point";
  CLASSIFICATION NETWORK_CONNECTION_POINT;
  CAN_DELETE FALSE;
  PROTOCOL HART;
  CONNECTION_POINT ConnectionPoint_TP5;
}
```

```
VARIABLE DevAddr
{
  LABEL "Address";
  CLASS DEVICE;
  TYPE UNSIGNED_INTEGER(5);
  HANDLING READ & WRITE;
```

```
}  
  
VARIABLE DevMfg  
{  
    LABEL "Manufacturer";  
    CLASS DEVICE;  
    TYPE UNSIGNED_INTEGER(2);  
    HANDLING READ & WRITE;  
}  
  
VARIABLE DevType  
{  
    LABEL "Device Type";  
    CLASS DEVICE;  
    TYPE UNSIGNED_INTEGER(2);  
    HANDLING READ & WRITE;  
}  
  
VARIABLE DevRev  
{  
    LABEL "Device Revision";  
    CLASS DEVICE;  
    TYPE UNSIGNED_INTEGER;  
    HANDLING READ & WRITE;  
}  
  
VARIABLE DevTag  
{  
    LABEL "Tag";  
    CLASS DEVICE;  
    TYPE ASCII(32);  
    HANDLING READ & WRITE;  
}  
  
VARIABLE DevPollAddr  
{  
    LABEL "Poll Address";  
    CLASS DEVICE;  
    TYPE UNSIGNED_INTEGER  
    {  
        MAX_VALUE 15; //Define appropriate max value for various revisions  
    }  
    HANDLING READ & WRITE;  
}  
  
COLLECTION ConnectionPoint_TP5  
{  
    LABEL "Connection Point";  
    MEMBERS  
    {  
        ADDRESS,    DevAddr,    "Device Address";  
        MFG,        DevMfg,     "Manufacturer";  
        DEV_TYPE,   DevType,    "Device Type";  
        DEV_REV,    DevRev,     "Device Revision";  
        TAG,        DevTag,     "Device Tag";  
        POLL_ADDR, DevPollAddr, "Poll Address";  
    }  
}
```

5.5.1.3 HART_IP

Le ConnectionPoint de type HART_IP doit être utilisé pour identifier la communication de réseau IP CP 9/1; il est défini dans le Tableau 10. Les communications HART_IP peuvent être utilisées sur une diversité de couches physiques. Toutes les connexions Ethernet doivent utiliser le type de connexion HART_IP. Les couches physiques supplémentaires qui seront développées dans le futur peuvent aussi utiliser le type de connexion HART_IP. Le ConnectionPoint de type HART_IP est un sous-type du type abstrait ConnectionPointType défini dans l'IEC 62769-5.

La propriété IPAddress doit indiquer l'adresse IP (jusqu'à 16 octets) utilisée pour la connexion.

La propriété IPVersion doit indiquer la version IP utilisée pour la connexion (version 4 ou 6).

La propriété IPPort doit être le numéro de port IP pour la connexion. Le numéro de port par défaut utilisé pour HART_IP est 5 094.

La propriété DevAddr doit correspondre à l'adresse longue (5 octets) de l'appareil.

La propriété DevMfg doit correspondre à l'ID fabricant de 2 octets; elle peut être utilisée pour favoriser l'automatisation du processus d'attribution des appareils actifs de la liste de balayage aux espaces réservés hors ligne.

La propriété DevType doit correspondre au type étendu d'appareil de 2 octets; elle peut être utilisée pour favoriser l'automatisation du processus d'attribution des appareils actifs de la liste de balayage aux espaces réservés hors ligne.

La propriété DevRev doit correspondre à la révision d'appareil; elle peut être utilisée pour favoriser l'automatisation du processus d'attribution des appareils actifs de la liste de balayage aux espaces réservés hors ligne.

La propriété DevTag doit correspondre au marqueur long (avec 32 caractères au maximum); elle peut être utilisée pour favoriser l'automatisation du processus d'attribution des appareils actifs de la liste de balayage aux espaces réservés hors ligne.

Tableau 10 – Définition du ConnectionPointType HART_IP

Attribut	Valeur				
BrowseName	ConnectionPoint_HART_IP				
IsAbstract	False				
Références	NodeClass	BrowseName	Data Type	TypeDefinition	ModellingRule
Hérite des propriétés de ConnectionPointType défini dans l'IEC 62769-5					
HasProperty	Variable	IPAddress	ByteString	PropertyType	Obligatoire
HasProperty	Variable	IPVersion	UInt8	PropertyType	Obligatoire
HasProperty	Variable	IPPort	UInt16	PropertyType	Obligatoire
HasProperty	Variable	DevAddr	UInt40	PropertyType	Obligatoire
HasProperty	Variable	DevMfg	UInt16	PropertyType	Facultatif
HasProperty	Variable	DevType	UInt16	PropertyType	Facultatif
HasProperty	Variable	DevRev	UInt16	PropertyType	Facultatif
HasProperty	Variable	DevTag	String	PropertyType	Facultatif

Le ConnectionPoint de type HART_IP doit être décrit par un élément EDD contenu dans le Paquetage FDI® associé à un Appareil de communication, qui peut piloter un réseau CP 9/1.

Les propriétés réelles de ConnectionPoint sont déclarées par les constructions VARIABLE regroupées dans une COLLECTION nommée ConnectionPoint_HART_IP. Le code source EDDL ci-après est un exemple qui décrit un Point de connexion IP.

```
COMPONENT ConnectionPoint_HART_IP
{
  LABEL "HART IP Connection Point";
  CLASSIFICATION NETWORK_CONNECTION_POINT;
  CAN_DELETE FALSE;
  PROTOCOL HART;
  CONNECTION_POINT ConnectionPoint_IP;
}

ARRAY IPAddress
{
  LABEL "IP Address";
  CLASS DEVICE;
  TYPE OCTET(16);
  HANDLING READ & WRITE;
}

VARIABLE IPVersion
{
  LABEL "IP Version";
  CLASS DEVICE;
  TYPE ENUMERATED
  {
    { 4, "IPv4" },
    { 6, "IPv6" }
  }
  HANDLING READ & WRITE;
}

VARIABLE IPPort
{
  LABEL "IP Port";
  CLASS DEVICE;
  TYPE UNSIGNED_INTEGER (2);
  DEFAULT_VALUE 5094;
  HANDLING READ & WRITE;
}

COLLECTION ConnectionPoint_IP
{
  LABEL "Connection Point";
  MEMBERS
  {
    IPADDRESS, IPAddress, "IP Address";
    IPVERSION, IPVersion, "IP Version";
    IPPORT, IPPort, "IP Port";
    ADDRESS, DevAddr, "Device Address";
    MFG, DevMfg, "Manufacturer";
    DEV_TYPE, DevType, "Device Type";
    DEV_REV, DevRev, "Device Revision";
    TAG, DevTag, "Device Tag";
  }
}
```

5.5.1.4 HART_TDMA

Le ConnectionPoint de type HART_TDMA doit être utilisé pour identifier une communication réseau à accès multiple par répartition dans le temps CP 9/2; il est défini dans le Tableau 11. Les communications HART_TDMA peuvent être utilisées sur une diversité de couches physiques. Le ConnectionPoint de type HART_TDMA est un sous-type du type abstrait ConnectionPointType défini dans l'IEC 62769-5. Toutes les connexions WirelessHART doivent utiliser le type de connexion HART_TDMA. Les couches physiques supplémentaires qui seront développées dans le futur peuvent aussi utiliser le type de connexion HART_TDMA.

La propriété Network doit correspondre à l'ID de réseau pour le réseau.

La propriété DevAddr doit correspondre à l'adresse longue (5 octets) de l'appareil.

La propriété DevMfg doit correspondre à l'ID fabricant de 2 octets; elle peut être utilisée pour favoriser l'automatisation du processus d'attribution des appareils actifs de la liste de balayage aux espaces réservés hors ligne.

La propriété DevType doit correspondre au type étendu d'appareil de 2 octets; elle peut être utilisée pour favoriser l'automatisation du processus d'attribution des appareils actifs de la liste de balayage aux espaces réservés hors ligne.

La propriété DevRev doit correspondre à la révision d'appareil; elle peut être utilisée pour favoriser l'automatisation du processus d'attribution des appareils actifs de la liste de balayage aux espaces réservés hors ligne.

La propriété DevTag doit correspondre au marqueur long (avec 32 caractères au maximum); elle peut être utilisée pour favoriser l'automatisation du processus d'attribution des appareils actifs de la liste de balayage aux espaces réservés hors ligne.

Tableau 11 – Définition du ConnectionPointType HART_TDMA

Attribut	Valeur				
BrowseName	ConnectionPoint_HART_TDMA				
IsAbstract	False				
Références	NodeClass	BrowseName	Data Type	TypeDefinition	ModellingRule
Hérite des propriétés de ConnectionPointType défini dans l'IEC 62769-5					
HasProperty	Variable	Network	UInt16	PropertyType	Obligatoire
HasProperty	Variable	DevAddr	UInt40	PropertyType	Obligatoire
HasProperty	Variable	DevMfg	UInt16	PropertyType	Facultatif
HasProperty	Variable	DevType	UInt16	PropertyType	Facultatif
HasProperty	Variable	DevRev	UInt16	PropertyType	Facultatif
HasProperty	Variable	DevTag	String	PropertyType	Facultatif

Le ConnectionPoint de type HART_TDMA doit être décrit par un élément EDD contenu dans le Paquetage FDI® associé à un Appareil de communication, qui peut piloter un réseau CP 9/2. Les propriétés réelles de ConnectionPoint sont déclarées par des constructions VARIABLE regroupées dans une COLLECTION nommée ConnectionPoint_HART_TDMA. Le code source EDDL ci-après est un exemple qui décrit un Point de connexion TDMA.

```

COMPONENT ConnectionPoint_HART_TDMA
{
    LABEL "HART TDMA Connection Point";
    CLASSIFICATION NETWORK_CONNECTION_POINT;
    CAN_DELETE FALSE;
    PROTOCOL HART;
    CONNECTION_POINT ConnectionPoint_TDMA;
}

VARIABLE Network
{
    LABEL "Network ID";
    CLASS DEVICE;
    TYPE UNSIGNED_INTEGER (2);
    HANDLING READ & WRITE;
}

COLLECTION ConnectionPoint_TDMA
{
    LABEL "Connection Point";
    MEMBERS
    {
        NETWORK, Network, "Network ID";
        ADDRESS, DevAddr, "Device Address";
        MFG, DevMfg, "Manufacturer";
        DEV_TYPE, DevType, "Device Type";
        DEV_REV, DevRev, "Device Revision";
        TAG, DevTag, "Device Tag";
    }
}

```

5.5.2 Définition de l'appareil de communication

Conformément à l'IEC 62769-7, chaque Paquetage de communication FDI® doit contenir un élément EDD qui décrit l'appareil de communication. Le code source EDDL ci-après est un exemple qui décrit un Serveur de communication FDI®.

```

COMPONENT CommunicationServer_HART
{
    LABEL "HART Communication Server";
    CAN_DELETE TRUE;
    CLASSIFICATION NETWORK_COMPONENT;
    COMPONENT_RELATIONS { Communication_Device_Setup_HART}
}

COMPONENT_RELATION Communication_Device_Setup_HART
{
    LABEL "Relation between Device and Communication Device";
    RELATION_TYPE CHILD_COMPONENT;
    COMPONENTS
    {
        CommunicationDevice_HART{AUTO_CREATE 1;}
    }
    MINIMUM_NUMBER 1;
    MAXIMUM_NUMBER 4;
}

```

La sémantique des constructions EDDL représentées ci-dessus est décrite dans l'IEC 62769-7. L'EDDL COMPONENT est utilisé par le Serveur FDI® et le Serveur de communication FDI® pour créer une instance du type CommunicationServerType, comme cela est décrit dans l'IEC 62769-7.

Conformément à l'IEC 62769-7, chaque Paquetage de communication FDI® doit contenir au moins un élément EDD qui décrit au moins un composant Appareil de communication. Le code source EDDL ci-après est un exemple qui décrit un appareil de communication CP 9/1.

```

COMPONENT CommunicationDevice_HART
{
  LABEL "HART Communication Device";
  CAN_DELETE TRUE;
  CLASSIFICATION NETWORK_COMPONENT;
  COMPONENT_RELATIONS { ServiceProviderRelation_HART}
  BYTE_ORDER BIG_ENDIAN;
}

COMPONENT_RELATION ServiceProviderRelation_HART
{
  LABEL "Relation to communication service provider";
  RELATION_TYPE CHILD_COMPONENT;
  COMPONENTS
  {
    CommunicationServiceProvider_HART {AUTO_CREATE 1;}
  }
  MINIMUM_NUMBER 1;
  MAXIMUM_NUMBER 1;
}

```

La sémantique des constructions EDDL représentées ci-dessus est décrite dans l'IEC 62769-7. L'EDDL COMPONENT est utilisé par le Serveur FDI® et le Serveur de communication FDI® pour créer une instance du type CommunicationServerChannelType, comme cela est décrit dans l'IEC 62769-7.

5.5.3 Définition du fournisseur de service de communication

Conformément à l'IEC 62769-7, chaque Paquetage de communication FDI® doit contenir au moins un élément EDD qui décrit au moins un composant Fournisseur de service de communication. Le code source EDDL ci-après est un exemple qui décrit un composant Fournisseur de service de communication CP 9/1.

La référence du composant ConnectionPoint_HART_IP correspond à l'une des définitions de Point de connexion associées, données en 5.5.1. La valeur de l'attribut BYTE_ORDER doit être définie en fonction du protocole.

```

COMPONENT CommunicationServiceProvider_HART
{
  LABEL "HART Communication Service Provider";
  CAN_DELETE FALSE;
  CLASSIFICATION NETWORK_COMMUNICATION_SERVICE_PROVIDER;
  COMPONENT_RELATIONS { ServiceProviderConnectionPointRelation_HART }
  BYTE_ORDER BIG_ENDIAN;
}

```

```

COMPONENT_RELATION ServiceProviderConnectionPointRelation_HART
{
  LABEL "Relation between communication service and connection point";
  RELATION_TYPE CHILD_COMPONENT;
  ADDRESSING
  {
    IPAddress
  }
  COMPONENTS
  {
    ConnectionPoint_HART_IP { AUTO_CREATE 1; }
  }
  MINIMUM_NUMBER 1;
  MAXIMUM_NUMBER 1;
}

```

La sémantique des constructions EDDL représentées ci-dessus est décrite dans l'IEC 62769-7. L'EDDL COMPONENT est utilisé par le Serveur FDI[®] et le Serveur de communication FDI[®] pour créer une instance du type CommunicationServiceType, comme cela est décrit dans l'IEC 62769-7.

5.5.4 Définition du Réseau

Conformément à l'IEC 62769-7, chaque Paquetage de communication FDI[®] doit contenir au moins un élément EDD qui décrit les contraintes de configuration réseau à l'aide de la construction COMPONENT. Le code source EDDL ci-après est un exemple qui décrit un réseau.

```

COMPONENT Network_HART
{
  LABEL "HART Network";
  CAN_DELETE TRUE;
  CLASSIFICATION NETWORK;
  COMPONENT_RELATIONS { NetworkConnectionPointRelation_HART }
}

```