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TECHNICAL REPORT

colour inside

Field device tool (FDT) interface specification – Part 509: Communication implementation for common object model – IEC 61784 CPF 9

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIELD DEVICE TOOL (FDT) INTERFACE SPECIFICATION –

Part 509: Communication implementation for common object model – IEC 61784 CPF 9

FOREWORD

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IEC/TR 62453-509, which is a technical report, has been prepared by subcommittee 65E: Devices and integration in enterprise systems, of IEC technical committee 65: Industrial-process measurement, control and automation:

This part, in conjunction with the other parts of the first edition of the IEC 62453 series cancels and replaces IEC/PAS 62453-1, IEC/PAS 62453-2, IEC/PAS 62453-3, IEC/PAS 62453-4 and IEC/PAS 62453-5 published in 2006, and constitutes a technical revision.

Each part of the IEC/TR 62453-5xy series is intended to be read in conjunction with its corresponding part in the IEC 62453-3xy series.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
65E/70/DTR	65E/119/RVC

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

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

The list of all parts of the IEC 62453 series, under the general title *Field Device Tool (FDT) interface specification*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The "colour inside" logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this publication using a colour printer.

INTRODUCTION

This part of IEC 62453 is an interface specification for developers of FDT (Field Device Tool) components for function control and data access within a client/server architecture. The specification is a result of an analysis and design process to develop standard interfaces to facilitate the development of servers and clients by multiple vendors that need to interoperate seamlessly.

With the integration of fieldbusses into control systems, there are a few other tasks which need to be performed. In addition to fieldbus- and device-specific tools, there is a need to integrate these tools into higher-level system-wide planning- or engineering tools. In particular, for use in extensive and heterogeneous control systems, typically in the area of the process industry, the unambiguous definition of engineering interfaces that are easy to use for all those involved is of great importance.

A device-specific software component, called DTM (Device Type Manager), is supplied by the field device manufacturer with its device. The DTM is integrated into engineering tools via the FDT interfaces defined in this specification. The approach to integration is in general open for all kind of fieldbusses and thus meets the requirements for integrating different kinds of devices into heterogeneous control systems.

Figure 1 shows how IEC/TR 62453-509 is aligned in the structure of IEC 62453 series.

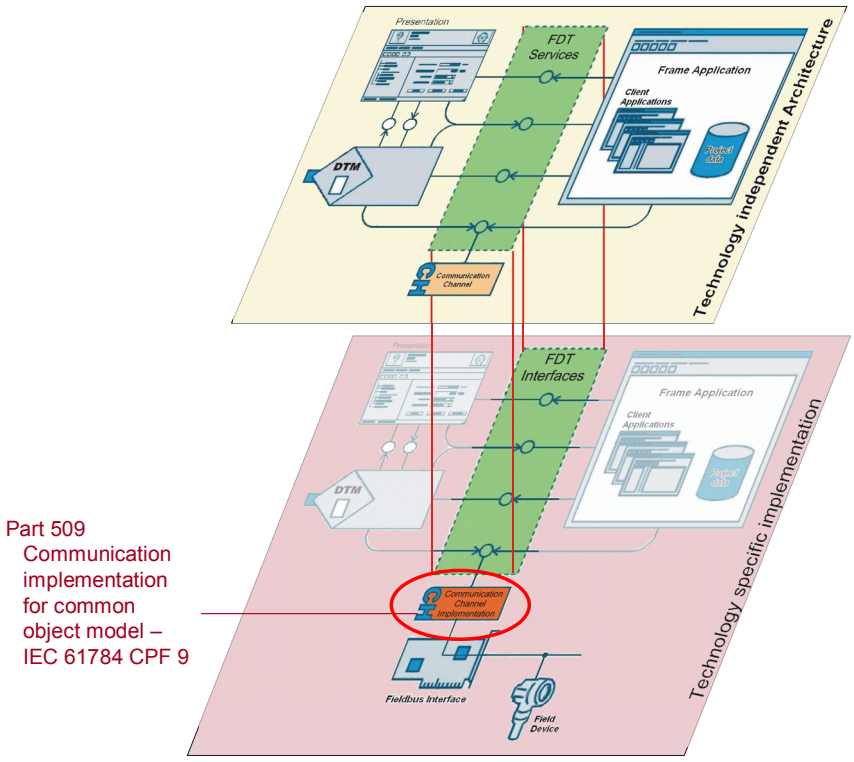

Figure 1 – Part 509 of the IEC 62453 series

FIELD DEVICE TOOL (FDT) INTERFACE SPECIFICATION –

Part 509: Communication implementation for common object model – IEC 61784 CPF 9

1 Scope

IEC/TR 62453-509, which is a technical report, provides information for integrating the HART®[1] technology into the FDT interface specification (IEC 62453-2).

This part of IEC 62453 specifies communication and other services.

This specification neither contains the FDT specification nor modifies it.

2 Normative references

The following referenced documents are indispensable for the application of this specification. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies

IEC 62453-1:2009, *Field Device Tool (FDT) interface specification – Part 1: Overview and guidance*

IEC 62453-2:2009, *Field Device Tool (FDT) interface specification – Part 2: Concepts and detailed description*

IEC/TR 62453-41:2009, *Field Device Tool (FDT) interface specification – Part 41: Object model integration profile – Common object model*

IEC 62453-309:2009, *Field Device Tool (FDT) interface specification – Part 309: Communication profile integration – IEC 61784 CPF 9*

3 Terms, definitions, symbols, abbreviated terms and conventions

3.1 Terms and definitions

For the purpose of this document, the terms and definitions given in IEC 62453-1, IEC 62453-2, and IEC/TR 62453-41 apply.

3.2 Symbols and abbreviated terms

For the purpose of this document, the symbols and abbreviations given in IEC 62453-1, IEC 62453-2, and IEC/TR 62453-41 apply.

---

[1] HART ® is the trade name of the product supplied by HART Communication Foundation. This information is given for convenience of users of this document and does not constitute an endorsement by IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

3.3 Conventions

3.3.1 Data type names and references to data types

The conventions for naming and referencing of data types are explained in IEC 62453-2 Clause A.1

3.3.2 Vocabulary for requirements

The following expressions are used when specifying requirements.

Usage of “shall” or “Mandatory”	No exceptions allowed.
Usage of “should” or “Recommended”	Strong recommendation. It may make sense in special exceptional cases to differ from the described behaviour.
Usage of “can’ or “Optional’	Function or behaviour may be provided, depending on defined conditions.

4 Bus category

IEC 61784 CPF 9 protocol is identified in the attribute busCategory of the BusCategory element by the identifiers, as specified in IEC 62453-309.

5 Access to instance and device data

Used at methods:

- IDtmParameter::GetParameters()
- IDtmParameter::SetParameters()

These methods shall provide access to at least to all parameters defined in IEC 62453-309.

6 Protocol specific usage of general data types

Table 1 shows how general data types are used with IEC 61784 CPF 9 devices.

Table 1 – Protocol specific usage of general data types

Attribute	Description for use
fdt:address	All these attributes of the FDTDatatype schema are used as defined in IEC 62453-309.
fdt:protocolId	
fdt:deviceTypeId	
fdt:deviceTypeInformation	
fdt:deviceTypeInformationPath	
fdt:manufacturerId	
fdt:semanticId	
fdt:applicationDomain	
fdt:tag	

7 Protocol specific common data types

This clause specifies the protocol specific common data types, which are used in the definition of other data types.

The data types described in this clause are defined for following namespace:
Namespace: <namespace identifier>

8 Network management data types

8.1 General

The data types specified in this clause are used at following methods:

- IDtmParameter:GetParameters
- IDtmParameter:SetParameters

8.2 HART device address

The element <BusInformation/@slaveAddress> (defined in IEC/TR 62453-41) is used for defining the network address of a device.

9 Communication data types – FDTHARTCommunicationSchema

The data types specified in this clause are used with the methods of IFdtCommunication.

The definition of the attribute follows the data type definition as defined in IEC 62453-309.

```
<Schema name="FDTHARTCommunicationSchema" xmlns="urn:schemas-microsoft-com:xml-data"
xmlns:dt="urn:schemas-microsoft-com:datatypes" xmlns:fdt="x-schema:FDTDataTypesSchema.xml">
    <!--Definition of Attributes-->
    <AttributeType name="schemaVersion" dt:type="number" default="1.21"/>
    <AttributeType name="address1" dt:type="ui1"/>
    <AttributeType name="address2" dt:type="ui1"/>
    <AttributeType name="address3" dt:type="ui1"/>
    <AttributeType name="commandNumber" dt:type="ui1"/>
    <AttributeType name="communicationReference" dt:type="uuid"/>
    <AttributeType name="deviceStatus" dt:type="ui1"/>
    <AttributeType name="deviceTypeId" dt:type="ui1"/>
    <AttributeType name="longFrameRequired" dt:type="boolean"/>
    <AttributeType name="manufacturerId" dt:type="ui1"/>
    <AttributeType name="preambleCount" dt:type="ui1"/>
    <AttributeType name="primaryMaster" dt:type="boolean"/>
    <AttributeType name="shortAddress" dt:type="ui1"/>
    <AttributeType name="value" dt:type="ui1"/>
    <AttributeType name="sequenceTime" dt:type="ui4"/>
    <AttributeType name="delayTime" dt:type="ui4"/>
        <AttributeType name="burstFrame" dt:type="boolean"/>
        <AttributeType name="burstModeDetected" dt:type="boolean"/>

    <!--Definition of Elements-->
    <ElementType name="CommunicationStatus" content="empty" model="closed">
        <attribute type="fdt:nodeId" required="no"/>
        <attribute type="value" required="yes"/>
    </ElementType>
    <ElementType name="CommandResponse" content="empty" model="closed">
        <attribute type="fdt:nodeId" required="no"/>
        <attribute type="value" required="yes"/>
    </ElementType>
    <ElementType name="Status" content="eltOnly" model="closed">
        <attribute type="fdt:nodeId" required="no"/>
        <attribute type="deviceStatus" required="yes"/>
```

```
        <group order="one" minOccurs="1" maxOccurs="1">
            <element type="CommunicationStatus"/>
            <element type="CommandResponse"/>
        </group>
    </ElementType>
    <ElementType name="LongAddress" content="empty" model="closed">
        <attribute type="fdt:nodeId" required="no"/>
        <attribute type="manufacturerId" required="yes"/>
        <attribute type="deviceTypeId" required="yes"/>
        <attribute type="address1" required="yes"/>
        <attribute type="address2" required="yes"/>
        <attribute type="address3" required="yes"/>
    </ElementType>
    <ElementType name="ShortAddress" content="empty" model="closed">
        <attribute type="fdt:nodeId" required="no"/>
        <attribute type="shortAddress" required="yes"/>
    </ElementType>
    <ElementType name="ConnectRequest" content="eltOnly" model="closed">
        <attribute type="fdt:nodeId" required="no"/>
        <attribute type="fdt:tag" required="yes"/>
        <attribute type="preambleCount" required="no"/>
        <attribute type="primaryMaster" required="no"/>
        <attribute type="longFrameRequired" required="no"/>
        <attribute type="fdt:systemTag" required="no"/>
        <element type="LongAddress" minOccurs="0" maxOccurs="1"/>
        <element type="ShortAddress" minOccurs="1" maxOccurs="1"/>
    </ElementType>
    <ElementType name="ConnectResponse" content="eltOnly" model="closed">
        <attribute type="fdt:nodeId" required="no"/>
        <attribute type="fdt:tag" required="yes"/>
        <attribute type="preambleCount" required="yes"/>
        <attribute type="primaryMaster" required="yes"/>
        <attribute type="communicationReference" required="yes"/>
        <element type="LongAddress" minOccurs="0" maxOccurs="1"/>
        <element type="ShortAddress" minOccurs="1" maxOccurs="1"/>
    </ElementType>
    <ElementType name="DisconnectRequest" content="empty" model="closed">
        <attribute type="fdt:nodeId" required="no"/>
        <attribute type="communicationReference" required="yes"/>
    </ElementType>
    <ElementType name="DisconnectResponse" content="empty" model="closed">
        <attribute type="fdt:nodeId" required="no"/>
        <attribute type="communicationReference" required="yes"/>
    </ElementType>
    <ElementType name="DataExchangeRequest" content="eltOnly" model="closed">
        <attribute type="fdt:nodeId" required="no"/>
        <attribute type="commandNumber" required="yes"/>
        <attribute type="communicationReference" required="yes"/>
        <element type="fdt:CommunicationData" minOccurs="0" maxOccurs="1"/>
    </ElementType>
    <ElementType name="DataExchangeResponse" content="eltOnly" model="closed">
        <attribute type="fdt:nodeId" required="no"/>
        <attribute type="commandNumber" required="yes"/>
        <attribute type="communicationReference" required="yes"/>
        <attribute type="burstFrame" required="no"/>
        <element type="fdt:CommunicationData" minOccurs="0" maxOccurs="1"/>
        <element type="Status" minOccurs="1" maxOccurs="1"/>
    </ElementType>
    <ElementType name="SequenceBegin" content="empty" model="closed">
        <attribute type="sequenceTime" required="no"/>
        <attribute type="delayTime" required="no"/>
        <attribute type="communicationReference" required="yes"/>
    </ElementType>
    <ElementType name="SequenceEnd" content="empty" model="closed">
        <attribute type="communicationReference" required="yes"/>
    </ElementType>
    <ElementType name="SequenceStart" content="empty" model="closed">
        <attribute type="communicationReference" required="yes"/>
    </ElementType>
    <ElementType name="Abort" content="empty" model="closed">
```

```
            <attribute type="communicationReference" required="no"/>
        </ElementType>
        <ElementType name="SubscribeRequest" content="empty" model="closed">
            <attribute type="fdt:nodeId" required="no"/>
            <attribute type="communicationReference" required="yes"/>
        </ElementType>
        <ElementType name="SubscribeResponse" content="empty" model="closed">
            <attribute type="fdt:nodeId" required="no"/>
            <attribute type="communicationReference" required="yes"/>
            <attribute type="burstModeDetected" required="yes"/>
            <attribute type="fdt:communicationError" required="no"/>
        </ElementType>
        <ElementType name="UnsubscribeRequest" content="empty" model="closed">
            <attribute type="fdt:nodeId" required="no"/>
            <attribute type="communicationReference" required="yes"/>
        </ElementType>
        <ElementType name="UnsubscribeResponse" content="empty" model="closed">
            <attribute type="fdt:nodeId" required="no"/>
            <attribute type="communicationReference" required="yes"/>
            <attribute type="fdt:communicationError" required="no"/>
        </ElementType>
        <ElementType name="FDT" content="eltOnly" model="closed">
            <attribute type="schemaVersion" required="no"/>
            <attribute type="fdt:nodeId" required="no"/>
            <group order="one" minOccurs="1" maxOccurs="1">
                <element type="ConnectRequest"/>
                <element type="ConnectResponse"/>
                <element type="DisconnectRequest"/>
                <element type="DisconnectResponse"/>
                <element type="DataExchangeRequest"/>
                <element type="DataExchangeResponse"/>
                <element type="SequenceBegin"/>
                <element type="SequenceEnd"/>
                <element type="SequenceStart"/>
                <element type="Abort"/>
                <element type="SubscribeRequest"/>
                <element type="SubscribeResponse"/>
                <element type="UnsubscribeRequest"/>
                <element type="UnsubscribeResponse"/>
                <element type="fdt:CommunicationError"/>
            </group>
        </ElementType>
</Schema>
```

Example:

```
<?xml version="1.0"?>
<FDT xmlns="x-schema:FDTHARTCommunicationSchema.xml" xmlns:fdt="x-schema:FDTDataTypesSchema.xml"
schemaVersion="1.21">
    <DataExchangeRequest fdt:nodeId="myId" commandNumber="42" communicationReference="6B29FC40-
CA47-1067-B31D-00DD010662DA"/>
</FDT>

<?xml version="1.0"?>
<FDT xmlns="x-schema:FDTHARTCommunicationSchema.xml" xmlns:fdt="x-schema:FDTDataTypesSchema.xml"
schemaVersion="1.21">
    <DataExchangeResponse commandNumber="1" communicationReference="6B29FC40-CA47-1067-B31D-
00DD010662DA">
        <fdt:CommunicationData byteArray="ff02"/>
        <Status deviceStatus="0">
            <CommandResponse value="1"/>
        </Status>
    </DataExchangeResponse>
</FDT>
```

Examples for IEC 61784 CPF 9 burst mode

The request from the DeviceDTM:

```
<?xml version="1.0"?>
<FDT xmlns="x-schema:FDTHARTCommunicationSchema.xml" xmlns:fdt="x-schema:FDTDataTypesSchema.xml">
    <SubscribeRequest fdt:nodeId="myId" communicationReference="6B29FC40-CA47-1067-B31D-
00DD010662DA"/>
</FDT>
```

Answer if the device is already in burst mode:

```
<?xml version="1.0"?>
<FDT xmlns="x-schema:FDTHARTCommunicationSchema.xml" xmlns:fdt="x-schema:FDTDataTypesSchema.xml">
    <SubscribeResponse communicationReference="6B29FC40-CA47-1067-B31D-00DD010662DA"
            burstModeDetected="1" />
</FDT>
```

Receiving a burst frame:

```
<FDT xmlns="x-schema:FDTHARTCommunicationSchema.xml" xmlns:fdt="x-schema:FDTDataTypesSchema.xml">
    <DataExchangeResponse commandNumber="1" communicationReference="6B29FC40-CA47-1067-B31D-
00DD010662DA" burstFrame=”1”>
        <fdt:CommunicationData byteArray="ff02"/>
        <Status deviceStatus="0">
            <CommandResponse value="1"/>
        </Status>
    </DataExchangeResponse>
</FDT>
```

Unsubscribing:

```
<FDT xmlns="x-schema:FDTHARTCommunicationSchema.xml" xmlns:fdt="x-schema:FDTDataTypesSchema.xml">
    <UnsubscribeRequest fdt:nodeId="myId" communicationReference="6B29FC40-CA47-1067-B31D-
00DD010662DA"/>
</FDT>
```

Answer to unsubscribe:

```
<?xml version="1.0"?>
<FDT xmlns="x-schema:FDTHARTCommunicationSchema.xml" xmlns:fdt="x-schema:FDTDataTypesSchema.xml">
    <UnsubscribeResponse communicationReference="6B29FC40-CA47-1067-B31D-00DD010662DA" />
</FDT>
```

10 Channel parameter data types – FDTHARTChannelParameterSchema

The XML document describes a how to access an IO value via an IEC 61784 CPF 9 command. The definition of the attributes and elements follows the definition of channel parameter data types as defined in IEC 62453-309.

The data types specified in this clause are used with the following methods:

- IFdtChannel::GetChannelParameters()
- IFdtChannel::SetChannelParameters()

```
<Schema name="FDTHARTChannelParameterSchema" xmlns="urn:schemas-microsoft-com:xml-data"
xmlns:dt="urn:schemas-microsoft-com:datatypes" xmlns:fdt="x-schema:FDTDataTypesSchema.xml"
xmlns:appId="x-schema:FDTApplicationIdSchema.xml">
    <!--Definition of Attributes-->
    <AttributeType name="schemaVersion" dt:type="number" default="1.21"/>
    <AttributeType name="byteLength" dt:type="ui1"/>
    <AttributeType name="commandNumber" dt:type="ui4"/>
    <AttributeType name="frameApplicationTag" dt:type="string"/>
    <AttributeType name="gatewayBusCategory" dt:type="uuid"/>
    <AttributeType name="protectedByChannelAssignment" dt:type="boolean"/>
    <AttributeType name="value" dt:type="string"/>
    <!--Definition of Elements-->
  <ElementType name="CommandParameters" content="empty" model="closed">
```

```
  <attribute type="fdt:nodeId" required="no"/>
  <attribute type="fdt:binData" required="no"/>
  <attribute type="byteLength" required="yes"/>
</ElementType>
  <ElementType name="Request" content="eltOnly" model="closed" order="many">
      <attribute type="fdt:nodeId" required="no"/>
          <group order="many">
    <element type="fdt:ChannelReference" minOccurs="0" maxOccurs="*"/>
    <element type="CommandParameters" minOccurs="0" maxOccurs="*"/>
   </group>
  </ElementType>
  <ElementType name="ResponseCodes" content="eltOnly" model="closed">
      <attribute type="fdt:nodeId" required="no"/>
      <element type="fdt:EnumeratorEntry" minOccurs="1" maxOccurs="*"/>
  </ElementType>
  <ElementType name="Reply" content="eltOnly" model="closed">
      <attribute type="fdt:nodeId" required="no"/>
          <group order="many">
    <element type="fdt:ChannelReference" minOccurs="0" maxOccurs="*"/>
    <element type="CommandParameters" minOccurs="0" maxOccurs="*"/>
   </group>
      <element type="ResponseCodes" minOccurs="0" maxOccurs="1"/>
  </ElementType>
  <ElementType name="ReadCommand" content="eltOnly" model="closed">
      <attribute type="fdt:nodeId" required="no"/>
      <attribute type="commandNumber" required="yes"/>
      <element type="Request" minOccurs="0" maxOccurs="1"/>
      <element type="Reply" minOccurs="0" maxOccurs="1"/>
      <element type="ResponseCodes" minOccurs="0" maxOccurs="1"/>
  </ElementType>
  <ElementType name="WriteCommand" content="eltOnly" model="closed">
      <attribute type="fdt:nodeId" required="no"/>
      <attribute type="commandNumber" required="yes"/>
      <element type="Request" minOccurs="0" maxOccurs="1"/>
      <element type="Reply" minOccurs="0" maxOccurs="1"/>
      <element type="ResponseCodes" minOccurs="0" maxOccurs="1"/>
  </ElementType>
  <ElementType name="FDTChannel" content="eltOnly" model="closed" order="seq">
      <attribute type="schemaVersion" required="no"/>
      <attribute type="fdt:nodeId" required="no"/>
      <attribute type="fdt:tag" required="yes"/>
      <attribute type="fdt:id" required="yes"/>
      <attribute type="fdt:descriptor" required="no"/>
      <attribute type="protectedByChannelAssignment" required="yes"/>
      <attribute type="fdt:dataType" required="yes"/>
      <attribute type="byteLength" required="yes"/>
      <attribute type="fdt:signalType" required="yes"/>
      <attribute type="frameApplicationTag" required="no"/>
      <attribute type="appId:applicationId" required="no"/>
      <element type="fdt:SemanticInformation" minOccurs="0" maxOccurs="*"/>
      <element type="fdt:BitEnumeratorEntries" minOccurs="0" maxOccurs="1"/>
      <element type="fdt:EnumeratorEntries" minOccurs="0" maxOccurs="1"/>
      <element type="fdt:Unit" minOccurs="0" maxOccurs="1"/>
      <element type="ReadCommand" minOccurs="0" maxOccurs="1"/>
      <element type="WriteCommand" minOccurs="0" maxOccurs="1"/>
      <element type="fdt:Alarms" minOccurs="0" maxOccurs="1"/>
      <element type="fdt:Ranges" minOccurs="0" maxOccurs="1"/>
          <element type="fdt:Deadband" minOccurs="0" maxOccurs="1"/>
      <element type="fdt:SubstituteValue" minOccurs="0" maxOccurs="1"/>
  </ElementType>
  <ElementType name="FDTChannelType" content="eltOnly" model="closed">
      <attribute type="fdt:nodeId" required="no"/>
      <element type="fdt:VersionInformation" minOccurs="1" maxOccurs="1"/>
      <attribute type="gatewayBusCategory" required="no"/>
  </ElementType>
  <ElementType name="FDT" content="eltOnly" model="closed">
      <attribute type="fdt:nodeId" required="no"/>
      <attribute type="schemaVersion" required="no"/>
      <element type="FDTChannelType" minOccurs="1" maxOccurs="1"/>
      <element type="FDTChannel" minOccurs="1" maxOccurs="1"/>
```

```
    </ElementType>
</Schema>

 Example:
<?xml version="1.0"?>
<FDT xmlns="x-schema:FDTHARTChannelParameterSchema.xml" xmlns:fdt="x-
schema:FDTDataTypesSchema.xml">
    <FDTChannelType>
        <fdt:VersionInformation name="myname" vendor="myVendor" version="1.0" date="2000-08-05"/>
    </FDTChannelType>
    <FDTChannel fdt:tag="myTag" fdt:id="PV" protectedByChannelAssignment="0" fdt:dataType="float"
byteLength="4" fdt:signalType="output">
        <ReadCommand commandNumber="1">
            <Reply>
                <fdt:ChannelReference idref="PV_UNIT"/>
                <fdt:ChannelReference idref="PV"/>
            </Reply>
            <ResponseCodes>
                <fdt:EnumeratorEntry index="8" name="Warning: Update Failure"/>
            </ResponseCodes>
        </ReadCommand>
        <fdt:Alarms>
            <fdt:Alarm alarmType="lowAlarm">
                <fdt:StaticValue staticValue="25"/>
            </fdt:Alarm>
            <fdt:Alarm alarmType="highAlarm">
                <fdt:StaticValue staticValue="100"/>
            </fdt:Alarm>
        </fdt:Alarms>
        <fdt:Ranges>
            <fdt:Range>
                <fdt:LowerRange>
                    <fdt:ChannelReference idref="PV_LOWER_RANGE_VALUE"/>
                </fdt:LowerRange>
                <fdt:UpperRange>
                    <fdt:ChannelReference idref="PV_UPPER_RANGE_VALUE"/>
                </fdt:UpperRange>
                <fdt:Unit>
                    <fdt:ChannelReference idref="PV_RANGE_VALUES_UNITS_CODE"/>
                </fdt:Unit>
            </fdt:Range>
        </fdt:Ranges>
    </FDTChannel>
</FDT>


<?xml version="1.0"?>
<FDT xmlns="x-schema:FDTHARTChannelParameterSchema.xml" xmlns:fdt="x-
schema:FDTDataTypesSchema.xml">
    <FDTChannelType>
        <fdt:VersionInformation name="myname" vendor="myVendor" version="1.0" date="2000-08-05"/>
    </FDTChannelType>
    <FDTChannel fdt:tag="myTag" fdt:id="PV_UNIT" protectedByChannelAssignment="0" fdt:dataType="byte"
byteLength="1" fdt:signalType="input">
        <fdt:EnumeratorEntries>
            <fdt:EnumeratorEntry index="7" name="bar"/>
            <fdt:EnumeratorEntry index="8" name="mbar"/>
        </fdt:EnumeratorEntries>
        <ReadCommand commandNumber="1">
            <Reply>
                <fdt:ChannelReference idref="PV_UNIT"/>
                <fdt:ChannelReference idref="PV"/>
            </Reply>
            <ResponseCodes>
                <fdt:EnumeratorEntry index="8" name="Warning: Update Failure"/>
            </ResponseCodes>
        </ReadCommand>
        <WriteCommand commandNumber="44">
            <Request>
                <fdt:ChannelReference idref="PV_UNIT"/>
```

```
            </Request>
            <Reply>
                <fdt:ChannelReference idref="PV_UNIT"/>
            </Reply>
        </WriteCommand>
    </FDTChannel>
</FDT>
```

11 Device identification

11.1 Device type identification data types – FDTHARTIdentSchema

The HARTIdentSchema provides elements and attributes with a protocol specific semantic as well as document nodes without such a mapping (data type definition in IEC 62453-309).

```
<Schema name="FDTHARTIdentSchema" xmlns="urn:schemas-microsoft-com:xml-data" xmlns:dt="urn:schemas-microsoft-com:datatypes">
    <!--Definition of Attributes-->
    <AttributeType name="schemaVersion" dt:type="number" default="1.21"/>
    <AttributeType name="busProtocol" dt:type="enumeration" dt:values="HART"/>
    <AttributeType name="universalCommandRevisionLevel" dt:type="ui1"/>
    <!-- Command 0 Byte 4 -->
    <AttributeType name="shortAddress" dt:type="ui1"/>
    <!-- Poll to check Command 0 response -->
    <AttributeType name="manufacturerIdentificationCode" dt:type="ui1"/>
    <!-- Command 0 Byte 1 -->
    <AttributeType name="deviceTypeID" dt:type="ui1"/>
    <!-- Command 0 Byte 2 -->
    <AttributeType name="softwareRevision" dt:type="ui1"/>
    <!-- Command 0 Byte 6 -->
    <AttributeType name="hardwareRevision" dt:type="float"/>
    <!-- Command 0 Byte 7 - conversion: xxxxx.yyy-->
    <AttributeType name="tag" dt:type="string"/>
    <!-- Command 13 Bytes 0 - 5  -->
    <AttributeType name="deviceID" dt:type="ui4"/>
    <!-- Command 0 Bytes 9 - 11 -->
    <!--                    end of semantic information for HART                    -->
    <AttributeType name="deviceCommandRevisionLevel" dt:type="ui1"/>
    <!-- Command 0 Byte 5 -->
    <AttributeType name="deviceFlag" dt:type="ui1"/>
    <!-- Command 0 Byte 8 -->
    <AttributeType name="manufacturerSpecificExtension" dt:type="string"/>
    <AttributeType name="idDTMSupportLevel" dt:type="enumeration" dt:values="genericSupport profileSupport blockspecificProfileSupport specificSupport identSupport"/>
    <AttributeType name="match" dt:type="string"/>
    <AttributeType name="nomatch" dt:type="string"/>
    <ElementType name="RegExpr" content="empty" model="closed">
        <attribute type="match" required="no"/>
        <attribute type="nomatch" required="no"/>
    </ElementType>
</Schema>
```

11.2 Topology scan data types – DTMHARTDeviceSchema

Used at IDtmEvents::OnScanResponse()

The XML document describes one entry in the list of scanned IEC 61784 CPF 9-Devices.

```
<?xml version="1.0"?>
<Schema name="DTMHARTDeviceSchema" xmlns="urn:schemas-microsoft-com:xml-data" xmlns:fdt="x-schema:FDTDataTypesSchema.xml" xmlns:fdthart="x-schema:FDTHARTCommunicationSchema.xml" xmlns:dtminfo="x-schema:DTMInformationSchema.xml" xmlns:dt="urn:schemas-microsoft-com:datatypes">
    <!--Definition of Attributes-->
    <AttributeType name="schemaVersion" dt:type="number" default="1.21"/>
    <!--Definition of Elements-->
    <ElementType name="HARTDevice" content="eltOnly" model="closed">
```

```
        <attribute type="fdt:nodeId" required="no"/>
        <attribute type="schemaVersion" required="no"/>
        <element type="fdthart:LongAddress" minOccurs="0" maxOccurs="1"/>
        <attribute type="fdthart:manufacturerId" required="no"/>
        <attribute type="fdthart:deviceTypeId" required="no"/>
        <attribute type="fdt:subDeviceType" required="no"/>
        <attribute type="fdt:tag" required="yes"/>
        <attribute type="fdthart:shortAddress" required="no"/>
    </ElementType>
</Schema>
```

11.3 Scan identification data types – FDTHARTScanIdentSchema

This schema defines the XML document provided by a scan response of a CIP network.

The schema defines attributes and elements that are used to provide protocol specific scanning.

```
<Schema name="FDTHARTScanIdentSchema" xmlns="urn:schemas-microsoft-com:xml-data"
xmlns:dt="urn:schemas-microsoft-com:datatypes" xmlns:hartident="x-schema:FDTHARTIdentSchema.xml"
xmlns:fdt="x-schema:FDTDataTypesSchema.xml">
    <!--Definition of Attributes-->
    <AttributeType name="schemaVersion" dt:type="number" default="1.21"/>
    <AttributeType name="resultState" dt:type="enumeration" dt:values="provisional final error"/>
    <AttributeType name="configuredState" dt:type="enumeration" dt:values="configuredAndPhysicallyAvailable
configuredAndNotPhysicallyAvailable availableButNotConfigured notApplicable"/>
    <!--Definition of elements-->
    <ElementType name="IdAddress" content="empty" model="closed">
        <attribute type="hartident:shortAddress" required="yes"/>
    </ElementType>
    <ElementType name="IdBusProtocol" content="empty" model="closed">
        <attribute type="hartident:busProtocol" required="yes"/>
    </ElementType>
    <ElementType name="IdBusProtocolVersion" content="empty" model="closed">
        <attribute type="hartident:universalCommandRevisionLevel" required="yes"/>
    </ElementType>
    <ElementType name="IdManufacturer" content="empty" model="closed">
        <attribute type="hartident:manufacturerIdentificationCode" required="yes"/>
    </ElementType>
    <ElementType name="IdTypeID" content="empty" model="closed">
        <attribute type="hartident:deviceTypeID" required="yes"/>
    </ElementType>
    <ElementType name="IdSoftwareRevision" content="empty" model="closed">
        <attribute type="hartident:softwareRevision" required="yes"/>
    </ElementType>
    <ElementType name="IdHardwareRevision" content="empty" model="closed">
        <attribute type="hartident:hardwareRevision" required="yes"/>
    </ElementType>
    <ElementType name="IdTag" content="empty" model="closed">
        <attribute type="hartident:tag" required="yes"/>
    </ElementType>
    <ElementType name="IdSerialNumber" content="empty" model="closed">
        <attribute type="hartident:deviceID" required="yes"/>
    </ElementType>
    <ElementType name="DeviceCommandRevisionLevel" content="empty" model="closed">
        <attribute type="hartident:deviceCommandRevisionLevel" required="yes"/>
    </ElementType>
    <ElementType name="DeviceFlag" content="empty" model="closed">
        <attribute type="hartident:deviceFlag" required="yes"/>
    </ElementType>
    <ElementType name="ManufacturerSpecificExtension" content="empty" model="closed">
        <attribute type="hartident:manufacturerSpecificExtension" required="yes"/>
    </ElementType>
    <ElementType name="ScanIdentification" content="eltOnly" model="closed">
        <attribute type="configuredState" required="no"/>
        <!--    attributes with semantic meaning: -->
        <element type="fdt:CommunicationError" minOccurs="0" maxOccurs="1"/>
        <element type="IdAddress" minOccurs="1" maxOccurs="1"/>
```

```
        <element type="IdBusProtocol" minOccurs="1" maxOccurs="1"/>
        <element type="IdBusProtocolVersion" minOccurs="1" maxOccurs="1"/>
        <element type="IdManufacturer" minOccurs="1" maxOccurs="1"/>
        <element type="IdTypeID" minOccurs="1" maxOccurs="1"/>
        <element type="IdSoftwareRevision" minOccurs="1" maxOccurs="1"/>
        <element type="IdHardwareRevision" minOccurs="1" maxOccurs="1"/>
        <element type="IdTag" minOccurs="1" maxOccurs="1"/>
        <element type="IdSerialNumber" minOccurs="1" maxOccurs="1"/>
        <!--    non semantic attributes: -->
        <element type="DeviceCommandRevisionLevel" minOccurs="1" maxOccurs="1"/>
        <element type="DeviceFlag" minOccurs="1" maxOccurs="1"/>
        <!--    manufacturer specific extension, added in manufacturer specific identification -->
        <element type="ManufacturerSpecificExtension" minOccurs="0" maxOccurs="1"/>
    </ElementType>
    <ElementType name="ScanIdentifications" content="eltOnly" model="closed">
        <attribute type="fdt:busCategory" required="yes"/>
        <attribute type="resultState" required="yes"/>
        <element type="ScanIdentification" minOccurs="0" maxOccurs="*"/>
    </ElementType>
    <ElementType name="FDT" content="eltOnly" model="closed">
        <element type="ScanIdentifications" minOccurs="1" maxOccurs="1"/>
    </ElementType>
</Schema>
```

11.4 Device type identification data types – FDTHARTDeviceIdentSchema

This subclause defines data types that are used to protocol specific information for device types.

The schema provides attributes and elements for providing protocol specific information for device types.

```
<Schema name="FDTHARTDeviceIdentSchema" xmlns="urn:schemas-microsoft-com:xml-data"
xmlns:dt="urn:schemas-microsoft-com:datatypes" xmlns:hartident="x-schema:FDTHARTIdentSchema.xml"
xmlns:ident="x-schema:DTMIdentSchema.xml" xmlns:fdt="x-schema:FDTDataTypesSchema.xml">
    <!--Definition of Attributes-->
    <AttributeType name="schemaVersion" dt:type="number" default="1.21"/>
    <ElementType name="IdBusProtocol" content="eltOnly" model="closed">
        <attribute type="hartident:busProtocol" required="no"/>
        <element type="hartident:RegExpr" minOccurs="0" maxOccurs="*"/>
    </ElementType>
    <ElementType name="IdBusProtocolVersion" content="eltOnly" model="closed">
        <attribute type="hartident:universalCommandRevisionLevel" required="no"/>
        <element type="hartident:RegExpr" minOccurs="0" maxOccurs="*"/>
    </ElementType>
    <ElementType name="IdManufacturer" content="eltOnly" model="closed">
        <attribute type="hartident:manufacturerIdentificationCode" required="no"/>
        <element type="hartident:RegExpr" minOccurs="0" maxOccurs="*"/>
    </ElementType>
    <ElementType name="IdTypeID" content="eltOnly" model="closed">
        <attribute type="hartident:deviceTypeID" required="no"/>
        <element type="hartident:RegExpr" minOccurs="0" maxOccurs="*"/>
    </ElementType>
    <ElementType name="IdSoftwareRevision" content="eltOnly" model="closed">
        <attribute type="hartident:softwareRevision" required="no"/>
        <element type="hartident:RegExpr" minOccurs="0" maxOccurs="*"/>
    </ElementType>
    <ElementType name="IdHardwareRevision" content="eltOnly" model="closed">
        <attribute type="hartident:hardwareRevision" required="no"/>
        <element type="hartident:RegExpr" minOccurs="0" maxOccurs="*"/>
    </ElementType>
    <ElementType name="DeviceCommandRevisionLevel" content="eltOnly" model="closed">
        <attribute type="hartident:deviceCommandRevisionLevel" required="no"/>
        <element type="hartident:RegExpr" minOccurs="0" maxOccurs="*"/>
    </ElementType>
    <ElementType name="DeviceFlag" content="eltOnly" model="closed">
        <attribute type="hartident:deviceFlag" required="no"/>
        <element type="hartident:RegExpr" minOccurs="0" maxOccurs="*"/>
```

```
    </ElementType>
    <ElementType name="ManufacturerSpecificExtension" content="empty" model="closed">
        <attribute type="hartident:manufacturerSpecificExtension" required="yes"/>
    </ElementType>
    <ElementType name="DeviceIdentification" content="eltOnly" model="closed">
        <attribute type="hartident:idDTMSupportLevel" required="yes"/>
        <element type="IdBusProtocol" minOccurs="1" maxOccurs="1"/>
        <element type="IdBusProtocolVersion" minOccurs="1" maxOccurs="1"/>
        <element type="IdManufacturer" minOccurs="1" maxOccurs="1"/>
        <element type="IdTypeID" minOccurs="1" maxOccurs="1"/>
        <element type="IdSoftwareRevision" minOccurs="1" maxOccurs="1"/>
        <element type="IdHardwareRevision" minOccurs="1" maxOccurs="1"/>
        <element type="DeviceCommandRevisionLevel" minOccurs="1" maxOccurs="1"/>
        <element type="DeviceFlag" minOccurs="1" maxOccurs="1"/>
        <!--    manufacturer specific extension, added in manufacturer specific identification -->
        <element type="ManufacturerSpecificExtension" minOccurs="0" maxOccurs="*"/>
    </ElementType>
    <ElementType name="DeviceIdentifications" content="eltOnly" model="closed">
        <attribute type="fdt:busCategory" required="yes"/>
        <element type="DeviceIdentification" minOccurs="1" maxOccurs="*"/>
    </ElementType>
    <ElementType name="FDT" content="eltOnly" model="closed">
        <element type="DeviceIdentifications" minOccurs="1" maxOccurs="1"/>
    </ElementType>
</Schema>
```

11.5 XSLT Transformation

```
<?xml version="1.0" encoding="UTF-8"?>

<!--
FDT: device identification transformation for HART device identification xml files
-->
<xsl:transform      xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
        xmlns:str="http://xsltsl.org/string"
        xmlns:ident="x-schema:DTMIdentSchema.xml"
        xmlns:fdt="x-schema:FDTDataTypesSchema.xml"
        xmlns:scanident="x-schema:DTMScanIdentSchema.xml"
        xmlns:devident="x-schema:DTMDeviceTypeIdentSchema.xml"
        xmlns:hartident="x-schema:FDTHARTIdentSchema.xml"
        xmlns:hartdevice="x-schema:FDTHARTDeviceTypeIdentSchema.xml"
        xmlns:hartscan="x-schema:FDTHARTScanIdentSchema.xml" version="2.0">
    <xsl:output method="xml" omit-xml-declaration="yes" indent="yes"/>
        <!--
FDT: version of this file
    -->

    <xsl:variable name="FileVersion">
        <xsl:number value="1.21"/>
    </xsl:variable>
    <xsl:output method="xml" omit-xml-declaration="yes" indent="yes"/>
<!--
root: transform device or scan identification
-->
    <xsl:template match="/">
            <xsl:apply-templates select="//hartscan:ScanIdentifications"/>
            <xsl:apply-templates select="//hartdevice:DeviceIdentifications"/>
    </xsl:template>
<!--
HART identification list
-->
    <xsl:template match="hartdevice:DeviceIdentifications">
        <xsl:text disable-output-escaping="yes">&lt;?xml version="1.0"?&gt;
    &lt;!-- This file is created by FDTxxxIdentTransformation.xsl after transformation of
xxxDTMDeviceIdentificationInstance.xml --&gt;
    &lt;FDT xmlns="x-schema:DTMDeviceTypeIdentSchema.xml"
     xmlns:ident="x-schema:DTMIdentSchema.xml" xmlns:fdt="x-schema:FDTDataTypesSchema.xml"
&gt;</xsl:text>
```

```
                <xsl:element name="DeviceIdentifications">
                    <xsl:apply-templates select="hartdevice:DeviceIdentification"/>
                </xsl:element>
        <xsl:text disable-output-escaping="yes">&lt;/FDT&gt;</xsl:text>
    </xsl:template>
<!--
HART catalog identifcation
-->
    <xsl:template match="hartdevice:DeviceIdentification">
            <xsl:element name="DeviceIdentification">
                <xsl:attribute name="ident:idDTMSupportLevel">
                    <xsl:value-of select="@hartident:idDTMSupportLevel"/>
                </xsl:attribute>
                <xsl:apply-templates select="hartdevice:IdBusProtocol"/>
                <xsl:apply-templates select="hartdevice:IdBusProtocolVersion"/>
                <xsl:apply-templates select="hartdevice:IdManufacturer"/>
                <xsl:apply-templates select="hartdevice:IdTypeID"/>
                <xsl:apply-templates select="hartdevice:IdSoftwareRevision"/>
                <xsl:apply-templates select="hartdevice:IdHardwareRevision"/>
                <xsl:element name="IdValues">
                    <xsl:apply-templates select="hartdevice:DeviceCommandRevisionLevel"/>
                    <xsl:apply-templates select="hartdevice:DeviceFlag"/>
                    <xsl:apply-templates select="hartdevice:ManufacturerSpecificExtension"/>
                </xsl:element>
            </xsl:element>
    </xsl:template>
<!--
HART scan list
-->
    <xsl:template match="hartscan:ScanIdentifications">
            <xsl:text disable-output-escaping="yes">&lt;?xml version="1.0"?&gt;
    &lt;!-- This file is created by FDTxxxIdentTransformation.xsl after transformation of
xxxDTMScanIdentificationInstance.xml --&gt;&lt;FDT xmlns="x-schema:DTMScanIdentSchema.xml"
     xmlns:ident="x-schema:DTMIdentSchema.xml" xmlns:fdt="x-schema:FDTDataTypesSchema.xml"
&gt;</xsl:text>
                <xsl:element name="ScanIdentifications">
                    <xsl:attribute name="fdt:busCategory">
                        <xsl:value-of select="@fdt:busCategory"/>
                    </xsl:attribute>
                    <xsl:attribute name="resultState">
                        <xsl:value-of select="@resultState"/>
                    </xsl:attribute>
                    <xsl:apply-templates select="hartscan:ScanIdentification"/>
                </xsl:element>
        <xsl:text disable-output-escaping="yes">&lt;/FDT&gt;</xsl:text>
    </xsl:template>


<!--
HART scan identifcation
-->
    <xsl:template match="hartscan:ScanIdentification">
            <xsl:element name="ScanIdentification">
                <xsl:apply-templates select="@configuredState" />
                <xsl:apply-templates select="fdt:CommunicationError"/>
                <xsl:apply-templates select="hartscan:IdBusProtocol"/>
                <xsl:apply-templates select="hartscan:IdBusProtocolVersion"/>
                <xsl:apply-templates select="hartscan:IdAddress"/>
                <xsl:apply-templates select="hartscan:IdManufacturer"/>
                <xsl:apply-templates select="hartscan:IdTypeID"/>
                <xsl:apply-templates select="hartscan:IdSoftwareRevision"/>
                <xsl:apply-templates select="hartscan:IdHardwareRevision"/>
                <xsl:apply-templates select="hartscan:IdTag"/>
                <xsl:apply-templates select="hartscan:IdSerialNumber"/>
                <xsl:element name="IdValues">
                    <xsl:apply-templates select="hartscan:DeviceCommandRevisionLevel"/>
                    <xsl:apply-templates select="hartscan:DeviceFlag"/>
                    <xsl:apply-templates select="hartscan:ManufacturerSpecificExtension"/>
                </xsl:element>
            </xsl:element>
```

```
    </xsl:template>
<!--
configured attribute
-->
    <xsl:template match="@configuredState">
        <xsl:attribute name="configuredState">
            <xsl:value-of select="."/>
        </xsl:attribute>
    </xsl:template>

<!--
HartScanIdentification: device tag, just copy
-->
    <xsl:template match="hartscan:IdTag">
        <xsl:element name="IdDeviceTag">
            <xsl:attribute name="ident:value"><xsl:value-of select="@hartident:tag"/></xsl:attribute>
            <xsl:attribute name="ident:protocolSpecificName">Tag</xsl:attribute>
        </xsl:element>
    </xsl:template>
<!--
HartScanIdentification: communicationError
-->
    <xsl:template match="fdt:CommunicationError">
        <xsl:element name="fdt:CommunicationError">
            <xsl:attribute name="communicationError"><xsl:value-of
select="@communicationError"/></xsl:attribute>
            <xsl:attribute name="tag"><xsl:value-of select="@tag"/></xsl:attribute>
        </xsl:element>
    </xsl:template>
<!--
HartScanIdentification: serialnumber
-->
    <xsl:template match="hartscan:IdSerialNumber">
        <xsl:element name="IdSerialNumber">
            <xsl:attribute name="ident:value"><xsl:value-of select="@hartident:deviceID"/></xsl:attribute>
            <xsl:attribute name="ident:protocolSpecificName">Device Identification Number</xsl:attribute>
        </xsl:element>
    </xsl:template>
<!--
HartScanIdentification: busaddress, just copy
-->
    <xsl:template match="hartscan:IdAddress">
        <xsl:element name="IdAddress">
            <xsl:attribute name="ident:value"><xsl:value-of select="@hartident:shortAddress"/></xsl:attribute>
            <xsl:attribute name="ident:protocolSpecificName">Polling Address</xsl:attribute>
        </xsl:element>
    </xsl:template>

<!--
HartScanIdentification: CommandRevision, saved as protocol specific value
-->
    <xsl:template match="hartdevice:DeviceCommandRevisionLevel">
        <xsl:param name="value" select="@hartident:deviceCommandRevisionLevel"/>
        <xsl:element name="IdValue">
            <xsl:attribute name="ident:name">DeviceCommandRevisionLevel</xsl:attribute>
            <xsl:call-template name="genMatch">
                <xsl:with-param name="value" select="$value"/>
            </xsl:call-template>
            <xsl:attribute name="ident:protocolSpecificName">Device Revision Level</xsl:attribute>
        </xsl:element>
    </xsl:template>
    <xsl:template match="hartscan:DeviceCommandRevisionLevel">
        <xsl:element name="IdValue">
            <xsl:attribute name="ident:name">DeviceCommandRevisionLevel</xsl:attribute>
            <xsl:attribute name="ident:value">
                <xsl:value-of select="@hartident:deviceCommandRevisionLevel"/>
            </xsl:attribute>
            <xsl:attribute name="ident:protocolSpecificName">Device Revision Level</xsl:attribute>
        </xsl:element>
    </xsl:template>
```

```
<!--
HartScanIdentification: DeviceFlag, saved as protocol specific value
-->
    <xsl:template match="hartdevice:DeviceFlag">
        <xsl:param name="value" select="@hartident:deviceFlag"/>
        <xsl:element name="IdValue">
            <xsl:attribute name="ident:name">DeviceFlag</xsl:attribute>
            <xsl:call-template name="genMatch">
                <xsl:with-param name="value" select="$value"/>
            </xsl:call-template>
            <xsl:attribute name="ident:protocolSpecificName">Flags</xsl:attribute>
        </xsl:element>
    </xsl:template>
    <xsl:template match="hartscan:DeviceFlag">
        <xsl:element name="IdValue">
            <xsl:attribute name="ident:name">DeviceFlag</xsl:attribute>
            <xsl:attribute name="ident:value">
                <xsl:value-of select="@hartident:deviceFlag"/>
            </xsl:attribute>
            <xsl:attribute name="ident:protocolSpecificName">Flags</xsl:attribute>
        </xsl:element>
    </xsl:template>
<!--
Hart Manufacaturer
-->
    <xsl:template match="hartdevice:IdManufacturer">
        <xsl:param name="manid" select="@hartident:manufacturerIdentificationCode"/>
        <xsl:element name="IdManufacturer">
            <xsl:call-template name="genMatch">
                <xsl:with-param name="value" select="$manid"/>
            </xsl:call-template>
            <xsl:attribute name="ident:protocolSpecificName">Manufacturer Identification Code</xsl:attribute>
        </xsl:element>
    </xsl:template>
    <xsl:template match="hartscan:IdManufacturer">
        <xsl:element name="IdManufacturer">
            <xsl:attribute name="ident:value">
                <xsl:value-of select="@hartident:manufacturerIdentificationCode"/>
            </xsl:attribute>
            <xsl:attribute name="ident:protocolSpecificName">Manufacturer Identification Code</xsl:attribute>
        </xsl:element>
    </xsl:template>
<!--
DevId:IdBusProtocol
-->
    <xsl:template match="hartdevice:IdBusProtocol">
        <xsl:param name="manid" select="@hartident:busProtocol"/>
        <xsl:element name="IdBusProtocol">
            <xsl:call-template name="genMatch">
                <xsl:with-param name="value" select="$manid"/>
            </xsl:call-template>
            <xsl:attribute name="ident:protocolSpecificName">HART</xsl:attribute>
        </xsl:element>
    </xsl:template>
    <xsl:template match="hartscan:IdBusProtocol">
        <xsl:element name="IdBusProtocol">
            <xsl:attribute name="ident:value">
                <xsl:value-of select="@hartident:busProtocol"/>
            </xsl:attribute>
            <xsl:attribute name="ident:protocolSpecificName">HART</xsl:attribute>
        </xsl:element>
    </xsl:template>
<!--
DevId:IdBusProtocolVersion
-->
    <xsl:template match="hartdevice:IdBusProtocolVersion">
        <xsl:param name="manid" select="@hartident:universalCommandRevisionLevel"/>
        <xsl:element name="IdBusProtocolVersion">
            <xsl:call-template name="genMatch">
                <xsl:with-param name="value" select="$manid"/>
```

```
            </xsl:call-template>
            <xsl:attribute name="ident:protocolSpecificName">HART Revision</xsl:attribute>
        </xsl:element>
    </xsl:template>
    <xsl:template match="hartscan:IdBusProtocolVersion">
        <xsl:element name="IdBusProtocolVersion">
            <xsl:attribute name="ident:value">
                <xsl:value-of select="@hartident:universalCommandRevisionLevel"/>
            </xsl:attribute>
            <xsl:attribute name="ident:protocolSpecificName">HART Revision</xsl:attribute>
        </xsl:element>
    </xsl:template>
<!--
HART device type
-->
    <xsl:template match="hartdevice:IdTypeID">
        <xsl:param name="value" select="@hartident:deviceTypeID"/>
        <xsl:element name="IdTypeID">
            <xsl:call-template name="genMatch">
                <xsl:with-param name="value" select="$value"/>
            </xsl:call-template>
            <xsl:attribute name="ident:protocolSpecificName">Device Type Code</xsl:attribute>
        </xsl:element>
    </xsl:template>
    <xsl:template match="hartscan:IdTypeID">
        <xsl:element name="IdTypeID">
            <xsl:attribute name="ident:value">
                <xsl:value-of select="@hartident:deviceTypeID"/>
            </xsl:attribute>
            <xsl:attribute name="ident:protocolSpecificName">Device Type Code</xsl:attribute>
        </xsl:element>
    </xsl:template>

<!--
HART software revision
-->
    <xsl:template match="hartdevice:IdSoftwareRevision">
        <xsl:param name="value" select="@hartident:softwareRevision"/>
        <xsl:element name="IdSoftwareRevision">
            <xsl:call-template name="genMatch">
                <xsl:with-param name="value" select="$value"/>
            </xsl:call-template>
            <xsl:attribute name="ident:protocolSpecificName">Software Revision</xsl:attribute>
        </xsl:element>
    </xsl:template>
        <xsl:template match="hartscan:IdSoftwareRevision">
        <xsl:param name="value" select="@hartident:softwareRevision"/>
        <xsl:element name="IdSoftwareRevision">
            <xsl:attribute name="ident:protocolSpecificName">Software Revision</xsl:attribute>
            <xsl:call-template name="genMatch">
                <xsl:with-param name="value" select="$value"/>
            </xsl:call-template>
        </xsl:element>
    </xsl:template>

<!--
HART hardware revision
-->
    <xsl:template match="hartdevice:IdHardwareRevision">
        <xsl:param name="value" select="@hartident:hardwareRevision"/>
        <xsl:element name="IdHardwareRevision">
            <xsl:attribute name="ident:protocolSpecificName">Hardware Revision</xsl:attribute>
            <xsl:call-template name="genMatch">
                <xsl:with-param name="value" select="$value"/>
            </xsl:call-template>
        </xsl:element>
    </xsl:template>
    <xsl:template match="hartscan:IdHardwareRevision">
        <xsl:param name="value" select="@hartident:hardwareRevision"/>
        <xsl:element name="IdHardwareRevision">
```

```
            <xsl:attribute name="ident:protocolSpecificName">Hardware Revision</xsl:attribute>
            <xsl:call-template name="genMatch">
                <xsl:with-param name="value" select="$value"/>
            </xsl:call-template>
        </xsl:element>
    </xsl:template>

<!--
ManufacturerSpecificExtension
-->
    <xsl:template match="hartdevice:ManufacturerSpecificExtension">
        <xsl:param name="value" select="@hartident:manufacturerSpecificExtension"/>
        <xsl:element name="IdValue">
            <xsl:attribute name="ident:name">ManufacturerSpecificExtension</xsl:attribute>
            <xsl:call-template name="genMatch">
                <xsl:with-param name="value" select="$value"/>
            </xsl:call-template>
            <xsl:attribute name="ident:protocolSpecificName">ManufacturerSpecificExtension</xsl:attribute>
        </xsl:element>
    </xsl:template>
    <xsl:template match="hartscan:ManufacturerSpecificExtension">
        <xsl:element name="IdValue">
            <xsl:attribute name="ident:name">ManufacturerSpecificExtension</xsl:attribute>
            <xsl:attribute name="ident:value">
                <xsl:value-of select="@hartident:manufacturerSpecificExtension"/>
            </xsl:attribute>
            <xsl:attribute name="ident:protocolSpecificName">ManufacturerSpecificExtension</xsl:attribute>
        </xsl:element>
    </xsl:template>


<!--
generate matching information
-->
    <xsl:template name="genMatch">
        <xsl:param name="value"/>
        <xsl:param name="empty"/>
        <xsl:if test="$value!=$empty">
            <xsl:attribute name="ident:value"><xsl:value-of select="$value"/></xsl:attribute>
        </xsl:if>
        <xsl:apply-templates select="hartident:RegExpr"/>
    </xsl:template>
<!--
generate regular exressions
-->
    <xsl:template match="hartident:RegExpr">
        <!-- copy pattern info -->
        <xsl:call-template name="genPattern">
            <xsl:with-param name="match" select="@match"/>
            <xsl:with-param name="nomatch" select="@nomatch"/>
        </xsl:call-template>
    </xsl:template>
<!--
generate pattern information
-->
    <xsl:template name="genPattern">
        <xsl:param name="match"/>
        <xsl:param name="nomatch"/>
        <xsl:param name="empty"/>
        <xsl:choose>
        <xsl:when test="$match!=$empty">
            <xsl:element name="ident:RegExpr">
                <xsl:attribute name="match"><xsl:value-of select="$match"/></xsl:attribute>
                <xsl:if test="$nomatch!=$empty">
                    <xsl:attribute name="nomatch"><xsl:value-of select="$nomatch"/></xsl:attribute>
                </xsl:if>
            </xsl:element>
        </xsl:when>
        <xsl:when test="$nomatch!=$empty">
            <xsl:element name="ident:RegExpr">
```

```
                <xsl:attribute name="nomatch"><xsl:value-of select="$nomatch"/></xsl:attribute>
                <xsl:if test="$match!=$empty">
                    <xsl:attribute name="match"><xsl:value-of select="$match"/></xsl:attribute>
                </xsl:if>
            </xsl:element>
        </xsl:when>
        </xsl:choose>
    </xsl:template>
</xsl:transform>
```

Bibliography

[1] *FDT Interface Specification V1.2*, Order No. of FDT Joint Interest Group: 0001-0001-001

[2] *FDT Interface Specification V1.2.1*, Order No. of FDT Group: 0001-0001-002

[3] IEC 61784-1, *Industrial communication networks – Profiles – Part 1: Fieldbus profiles*

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