IEC TR 62453-51-90

Edition 1.0 2017-06

TECHNICAL REPORT

colour inside

Field device tool (FDT) interface specification – Part 51-90: Communication implementation for common object model – IEC 61784 CPF 9

IEC TR 62453-51-90:2017-06(en)

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FIELD DEVICE TOOL (FDT) INTERFACE SPECIFICATION –

Part 51-90: Communication implementation for common object model – IEC 61784 CPF 9

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IEC TR 62453-51-90, which is a technical report, has been prepared by subcommittee 65E: Devices and integration in enterprise systems, of IEC technical committee 65: Industrial-process management, control and automation.

This document cancels and replaces IEC TR 62453-509 published in 2009. This edition constitutes a technical revision. The main changes provide support for the updated HART protocol.

Each part of the IEC 62453-51-xy series is intended to be read in conjunction with its corresponding part in the IEC 62453-3xy series. This document corresponds to IEC 63453-309.

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

Enquiry draft	Report on voting
65E/440/DTR	65E/514/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 document 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 document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document 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- withdrawn,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 document using a colour printer.

INTRODUCTION

This part of IEC 62453 is an interface specification for developers of Field Device Tool (FDT) 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 fieldbuses 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 Device Type Manager (DTM), 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 fieldbuses and thus meets the requirements for integrating different kinds of devices into heterogeneous control systems.

Figure 1 shows how this part of IEC 62453-51-xy series is aligned in the structure of the IEC 62453 series.

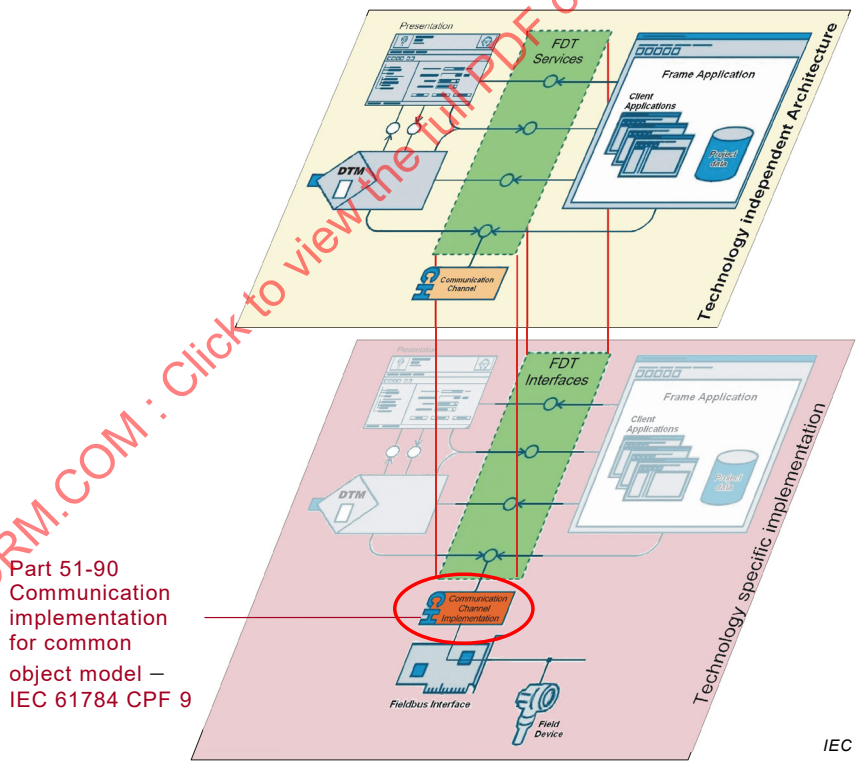

Figure 1 – Part 51-90 of the IEC 62453 series

FIELD DEVICE TOOL (FDT) INTERFACE SPECIFICATION –

Part 51-90: Communication implementation for common object model – IEC 61784 CPF 9

1 Scope

This part of the IEC 62453-51-xy series, which is a Technical Report, provides information for integrating the HART®[1] technology into the COM-based implementation of FDT interface specification (IEC TR 62453-41).

This part of IEC 62453 specifies the implementation of communication and other services based on IEC 62453-309.

This document neither contains the FDT specification nor modifies it.

2 Normative references

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

IEC 61784-1:2014, *Industrial communication networks – Profiles – Part 1: Fieldbus profiles*

IEC 62453-1:2016, *Field device tool (FDT) interface specification – Part 1: Overview and guidance*

IEC 62453-2:2016, *Field device tool (FDT) interface specification – Part 2: Concepts and detailed description*

IEC TR 62453-41:2016, *Field device tool (FDT) interface specification – Part 41: Object model integration profile – Common object model*

IEC 62453-309:2016, *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 purposes of this document, the terms and definitions given in IEC 62453-1, IEC 62453-2, IEC TR 62453-41 and IEC 62453-309 apply.

[1] HART ® is the trade name of a 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.

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

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

3.2 Symbols and abbreviated terms

For the purposes of this document, the symbols and abbreviations given in IEC 62453-1, IEC 62453-2, IEC 62453-309, and IEC TR 62453-41 apply.

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 62453-2:2016, 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 methods
- IDtmSingleDeviceDataAccess methods
- IDtmSingleInstanceDataAccess methods

These methods (if supported according IEC TR 62453-41) shall provide access to at least 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 the 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

9.1 General

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.

9.2 General communication – FDTHARTCommunicationSchema

This schema is used for communication of all protocols.

```
<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 are given below.

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>
```

9.3 ConnectRequest for ‘Extended_HART’ protocols

This schema is used for creating a connection for the Extended_HART protocols.

```
<?xml version="1.0" encoding="UTF-8"?>
<Schema name="FDTHART_ExtendedCommunicationSchema"
 xmlns="urn:schemas-microsoft-com:xml-data" xmlns:fdt="x-schema:FDTDataTypesSchema.xml"
 xmlns:dt="urn:schemas-microsoft-com:datatypes">
  <!--Definition of Attributes-->
  <AttributeType name="schemaVersion" dt:type="number" default="1.22"/>
  <AttributeType name="preambleCount" dt:type="ui1"/>
  <AttributeType name="primaryMaster" dt:type="boolean"/>
  <AttributeType name="shortAddress" dt:type="ui1"/>
  <AttributeType name="shortTag" dt:type="string"/>
  <AttributeType name="longTag" dt:type="string"/>
  <AttributeType name="ipAddress" dt:type="string"/>
  <AttributeType name="ipVersion" dt:type="enumeration" dt:values="IPv4 IPv6"/>
  <AttributeType name="port" dt:type="ui4"/>
  <AttributeType name="longAddressByte1" dt:type="ui1"/>
  <AttributeType name="longAddressByte2" dt:type="ui1"/>
  <AttributeType name="longAddressByte3" dt:type="ui1"/>
  <AttributeType name="longAddressByte4" dt:type="ui1"/>
  <AttributeType name="longAddressByte5" dt:type="ui1"/>
  <AttributeType name="networkID" dt:type="ui2"/>
  <AttributeType name="addressingMode"
   dt:type="enumeration"
   dt:values="shortAddress shortTag longTag"/>
  <!--Definition of Elements-->
  <ElementType name="ConnectRequest" content="empty" model="closed">
    <attribute type="fdt:nodeId" required="no"/>
    <attribute type="preambleCount" required="no"/>
    <!-- Provides a hint for the communication component about the number of preambles, required by the device type. -->
    <attribute type="primaryMaster" required="no"/>
    <!-- Provides a hint for a communication component that a DTM requires communication as primary or secondary master. -->
    <attribute type="fdt:systemTag" required="no"/>
    <!-- Unique identification of DTM within the Frame Application. -->
    <!-- Address information -->
    <attribute type="shortAddress" required="yes"/>
    <!-- This attribute is intended to store the short address (see CMD#0) information. -->
    <attribute type="longTag" required="yes"/>
    <!-- This attribute is intended to store the LongTag (see CMD#20) information. -->
    <attribute type="shortTag" required="yes"/>
    <!-- This attribute has store the Tag (see CMD#13). -->
    <attribute type="ipAddress" required="no"/>
    <!-- This attribute stores a host name or an IP address of a HART TCP or UDP device, conformant to IPv4 or IPv6 standard. -
->
    <attribute type="ipVersion" required="no"/>
    <!-- This attribute stores the internet protocol version. -->
    <attribute type="port" required="no"/>
    <!-- This attribute stores the port number of a HART TCP or UDP device -->
    <attribute type="longAddressByte1" required="yes"/>
    <!-- This attribute is intended to store the byte1 of the long address information. -->
    <attribute type="longAddressByte2" required="yes"/>
    <!-- This attribute is intended to store the byte2 of the long address information. -->
    <attribute type="longAddressByte3" required="yes"/>
    <!-- This attribute is intended to store the byte3 of the long address information. -->
    <attribute type="longAddressByte4" required="yes"/>
    <!-- This attribute is intended to store the byte4 of the long address information. -->
    <attribute type="longAddressByte5" required="yes"/>
    <!-- This attribute is intended to store the byte5 of the long address information. -->
    <attribute type="networkID" required="no"/>
    <!-- This attribute stores the network ID of a HART Wireless device. -->
    <attribute type="addressingMode" required="yes"/>
    <!-- With this attribute the parent DTM defines which address property shall be used for the connection -->
  </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"/>
    </group>
  </ElementType>
</Schema>
```

10 Channel parameter data types – FDTHARTChannelParameterSchema

The XML document describes 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 –

11.1.1 Identification schema for protocol 'HART' – 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>
```

11.1.2 Identification schema for 'Extended_HART' protocols – FDTHART_ExtendedIdentSchema

The FDTHART_ExtendedIdentSchema provides support for 'Extended_Hart' protocols.

```
<Schema name="FDTHART_ExtendedIdentSchema" xmlns="urn:schemas-microsoft-com:xml-data" xmlns:dt="urn:schemas-microsoft-com:datatypes">
 <!--Definition of Attributes-->
 <AttributeType name="schemaVersion" dt:type="number" default="1.0"/>
 <AttributeType name="busProtocol" dt:type="enumeration" dt:values="HART_FSK HART_Wireless HART_RS485 HART_Infrared HART_IP"/>
 <AttributeType name="universalCommandRevisionLevel" dt:type="ui1"/>
 <!-- Command 0 Byte 4 -->
 <AttributeType name="manufacturerIdentificationCode" dt:type="ui2"/>
 <!-- HART 5+6: Command 0 Byte 1, HART 7: Command 0 Byte 17+18 -->
 <AttributeType name="deviceTypeID" dt:type="ui2"/>
 <!-- HART 5+6: Command 0 Byte 2 , HART 7: Command 0 Byte 1+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="deviceID" dt:type="ui4"/>
 <!-- Command 0 Bytes 9 – 11 -->
 <AttributeType name="tag" dt:type="string"/>
 <!-- HART6 or 7: Command 20, HART5: Command 13 Bytes 0 – 5  -->

 <AttributeType name="deviceCommandRevisionLevel" dt:type="ui1"/>
 <!-- Command 0 Byte 5 -->
 <AttributeType name="deviceFlag" dt:type="ui1"/>
 <!-- Command 0 Byte 8 -->

 <!-- Address information -->
 <AttributeType name="shortAddress" dt:type="ui1"/>
 <!-- Poll to check Command 0 response -->
 <AttributeType name="shortTag" dt:type="string"/>
 <!-- Command 13 Bytes 0 – 5  -->
 <AttributeType name="longTag" dt:type="string"/>
 <!-- HART6 or 7: Command 20, HART5: Command 13 Bytes 6 – 17  -->
 <AttributeType name="ipAddress" dt:type="string"/>
 <!-- Ip Address of a HART UDP or HART TCP device -->
 <AttributeType name="ipVersion" dt:type="enumeration" dt:values="IPv4 IPv6"/>
 <AttributeType name="port" dt:type="ui4"/>
 <!--Port of a HART UDP or HART TCP device-->
 <AttributeType name="longAddressByte1" dt:type="ui1"/>
 <AttributeType name="longAddressByte2" dt:type="ui1"/>
 <AttributeType name="longAddressByte3" dt:type="ui1"/>
 <AttributeType name="longAddressByte4" dt:type="ui1"/>
 <AttributeType name="longAddressByte5" dt:type="ui1"/>
 <AttributeType name="networkID" dt:type="ui2"/>
 <AttributeType name="addressingMode" dt:type="enumeration" dt:values="shortAddress shortTag longTag longAddress"/>
 <!-- With this attribute the parent DTM defines which address property shall be used for the connection -->

 <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>
```

An example for using an inline schema in a scan-response is given below:

```
<?xml version="1.0"?>
<FDT xmlns:fdt="x-schema:FDTDataTypesSchema.xml">
  <!-- Schema section -->
  <Schema name="DTMHART_ExtendedDeviceSchema" xmlns="urn:schemas-microsoft-com:xml-data"
          xmlns:dt="urn:schemas-microsoft-com:datatypes">
    <!--Definition of Attributes-->
    <AttributeType name="schemaVersion" dt:type="number" default="1.22"/>
    <AttributeType name="manufacturerIdentificationCode" dt:type="ui2"/>
    <AttributeType name="deviceTypeID" dt:type="ui2"/>
    <AttributeType name="shortAddress" dt:type="ui1"/>
    <AttributeType name="shortTag" dt:type="string"/>
    <AttributeType name="longTag" dt:type="string"/>
    <AttributeType name="ipAddress" dt:type="string"/>
    <AttributeType name="ipVersion" dt:type="enumeration" dt:values="IPv4 IPv6"/>
    <AttributeType name="port" dt:type="ui4"/>
    <AttributeType name="addressingMode" dt:type="enumeration"
                   dt:values="shortAddress shortTag longTag longAddress"/>
    <AttributeType name="deviceID" dt:type="ui4"/>
    <AttributeType name="busProtocol" dt:type="enumeration" dt:values="HART_FSK HART_Wireless HART_RS485
HART_Infrared HART_IP"/>
    <AttributeType name="universalCommandRevisionLevel" dt:type="ui1"/>
    <AttributeType name="softwareRevision" dt:type="ui1"/>
    <AttributeType name="longAddressByte1" dt:type="ui1"/>
    <AttributeType name="longAddressByte2" dt:type="ui1"/>
    <AttributeType name="longAddressByte3" dt:type="ui1"/>
    <AttributeType name="longAddressByte4" dt:type="ui1"/>
    <AttributeType name="longAddressByte5" dt:type="ui1"/>
    <AttributeType name="networkID" dt:type="ui2"/>
    <!--Definition of Elements-->
    <ElementType name="HARTDevice" content="empty" model="closed">
      <attribute type="fdt:nodeId" required="no"/>
      <attribute type="schemaVersion" required="no"/>
      <attribute type="busProtocol" required="yes"/>
      <!-- Information about device type -->
      <attribute type="universalCommandRevisionLevel" required="yes"/>
      <attribute type="softwareRevision" required="yes"/>
      <attribute type="manufacturerIdentificationCode" required="yes"/>
      <attribute type="deviceTypeID" required="yes"/>
      <attribute type="fdt:subDeviceType" required="no"/>
      <!-- Device identity -->
      <attribute type="deviceID" required="yes"/>
      <!-- Address informaton -->
      <attribute type="longTag" required="yes"/>
      <attribute type="shortTag" required="yes"/>
      <attribute type="shortAddress" required="yes"/>
      <attribute type="addressingMode" required="yes"/>
      <attribute type="ipAddress" required="no"/>
      <attribute type="port" required="no"/>
      <attribute type="ipVersion" required="no"/>
      <attribute type="longAddressByte1" required="yes"/>
      <attribute type="longAddressByte2" required="yes"/>
      <attribute type="longAddressByte3" required="yes"/>
      <attribute type="longAddressByte4" required="yes"/>
      <attribute type="longAddressByte5" required="yes"/>
      <attribute type="networkID" required="no"/>
    </ElementType>
    <ElementType name="TopologyScan" content="eltOnly" model="open">
      <attribute type="fdt:nodeId" required="no"/>
      <group order="one">
        <element type="HARTDevice" minOccurs="0" maxOccurs="*"/>
```

```
    </group>
   </ElementType>
  </Schema>

  <!-- Data section (example)-->
  <TopologyScan>
   <HARTDevice xmlns="x-schema:#DTMHART_ExtendedDeviceSchema"
                        universalCommandRevisionLevel="7"
                        softwareRevision="1"
                        manufacturerIdentificationCode="98"
                        deviceTypeID="25308"
                        longTag="myTag"
                        shortTag="MYTAG"
                        shortAddress="7"
                        addressingMode="shortAddress"
                        deviceID="1234567"
                        busProtocol="HART_FSK"
    longAddressByte1="10"
    longAddressByte2="11"
    longAddressByte3="12"
    longAddressByte4="13"
    longAddressByte5="14"/>
  </TopologyScan>
</FDT>
```

11.3 Scan identification data types

11.3.1 General

The schemas in this subclause define 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.

11.3.2 Scan for protocol 'HART' – FDTHARTScanIdentSchema

The schema defines scan support for protocol 'HART'.

```
<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>
```

11.3.3 Scan for ‘Extended_HART’ protocols – FDTHART_ExtendedScanIdentSchema

The schema defines scan support for the ‘Extended_HART’ protocols.

```
<Schema name="FDTHART_ExtendedScanIdentSchema" xmlns="urn:schemas-microsoft-com:xml-data"
xmlns:dt="urn:schemas-microsoft-com:datatypes" xmlns:hartident="x-schema:FDTHART_ExtendedIdentSchema.xml"
xmlns:fdt="x-schema:FDTDataTypesSchema.xml">
  <!--Definition of Attributes-->
  <AttributeType name="schemaVersion" dt:type="number" default="1.0"/>
  <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-->
  <!--Address information -->
  <ElementType name="IdAddress" content="empty" model="closed">
    <attribute type="hartident:shortAddress" required="yes"/>
    <attribute type="hartident:shortTag" required="yes"/>
    <attribute type="hartident:longTag" required="yes"/>
    <attribute type="hartident:ipAddress" required="no"/>
    <attribute type="hartident:ipVersion" required="no"/>
    <attribute type="hartident:port" required="no"/>
    <attribute type="hartident:longAddressByte1" required="yes"/>
    <attribute type="hartident:longAddressByte2" required="yes"/>
    <attribute type="hartident:longAddressByte3" required="yes"/>
    <attribute type="hartident:longAddressByte4" required="yes"/>
    <attribute type="hartident:longAddressByte5" required="yes"/>
    <attribute type="hartident:networkID" required="no"/>
    <attribute type="hartident:addressingMode" 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="IdTag" content="empty" model="closed">
  <attribute type="hartident:tag" 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="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="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"/>
  <element type="IdAddress" 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>
```

An example for an FDT 1.2.1 HART DTM scan result for ‘Extended_HART’ protocols is shown below:

```
<?xml version="1.0" encoding="UTF-8"?>
<FDT xmlns:DevScanId="x-schema:FDTHART_ExtendedScanIdentSchema.xml"
 xmlns:hartident="x-schema:FDTHART_ExtendedIdentSchema.xml"
 xmlns:fdt="x-schema:FDTDataTypesSchema.xml">
  <DevScanId:ScanIdentifications
            fdt:busCategory=" 74D29D22-F752-40EF-A747-ACA72C791155"
            resultState="final">
   <DevScanId:ScanIdentification configuredState="configuredAndPhysicallyAvailable">
    <DevScanId:IdBusProtocol
                              hartident:busProtocol="HART"/>
    <DevScanId:IdBusProtocolVersion
                              hartident:universalCommandRevisionLevel="5"/>
    <DevScanId:IdManufacturer
                              hartident:manufacturerIdentificationCode="17"/>
    <DevScanId:IdTypeID
                              hartident:deviceTypeID="200"/>
```

```
    <DevScanId:IdSoftwareRevision
                                hartident:softwareRevision="11"/>
    <DevScanId:IdHardwareRevision
                                hartident:hardwareRevision="1.0"/>
    <DevScanId:IdTag
                                hartident:tag="myTag"/>
    <DevScanId:IdSerialNumber
                                hartident:deviceID="513"/>
    <DevScanId:IdAddress
        hartident:shortAddress="0"
        hartident:shortTag="myTag"
        hartident:longTag="myTag"
        hartident:networkID="3000"
        hartident:longAddressByte1="10"
        hartident:longAddressByte2="10"
        hartident:longAddressByte3="10"
        hartident:longAddressByte4="10"
        hartident:longAddressByte5="10"
        hartident:addressingMode="longTag"/>
    <DevScanId:DeviceCommandRevisionLevel
         hartident:deviceCommandRevisionLevel="2"/>
    <DevScanId:DeviceFlag
                                hartident:deviceFlag="0"/>
   </DevScanId:ScanIdentification>
  </DevScanId:ScanIdentifications>
</FDT>
```

For Parent DTMs, Frame Application can use the protocol specific xsl, to transform the scan response to protocol independent document. The DTM assignment can then be executed based on the protocol independent information.

DTMs supporting extended manufacturer and device type code shall use the 'Extended_Hart' protocolIds instead of the 'HART' protocolId.

11.4 Device type identification data types

11.4.1 General

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

The schemas provide attributes and elements for providing protocol specific information for device types.

11.4.2 Identification for protocol 'HART' – FDTHARTDeviceIdentSchema

The schema FDTHARTDeviceIdentSchema defines identification support for protocol 'HART'.

```
<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>
```

11.4.3 Identification for 'Extended_HART' protocols – FDTHART_ExtendedDeviceIdentSchema

The schema FDTHART_ExtendedDeviceIdentSchema defines identification support for 'Extended_HART' protocols.

```
<Schema name="FDTHART_ExtendedDeviceIdentSchema" xmlns="urn:schemas-microsoft-com:xml-data"
xmlns:dt="urn:schemas-microsoft-com:datatypes" xmlns:hartident="x-schema:FDTHART_ExtendedIdentSchema.xml"
xmlns:ident="x-schema:DTMIdentSchema.xml" xmlns:fdt="x-schema:FDTDataTypesSchema.xml">
 <!--Definition of Attributes-->
 <AttributeType name="schemaVersion" dt:type="number" default="1.0"/>
 <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

11.5.1 XSLT Transformation for protocol 'HART'

The transformation rules defined below are applied only for the protocol 'HART':

```
<?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>
```

11.5.2 Transformation for ‘Extended_HART’ protocols

The protocol specific transformation style sheets (.xsl) are required to transform the additional protocol specific information in FDTHART_ExtendedScanIdentSchema into a protocol independent DTMScanIdentSchema format. Frame Application uses this xsl to convert the protocol specific information in the scan response to a protocol independent format.

The transformation listed in this subclause is mainly the same as for the ‘HART’ protocol. There is only a change in building the value of the node “IdAddress”. The IdAddress for the ‚Extended_HART‘ ProtocolIds is now formatted like:

<shortAddress>|<shortTag>|<ipAddress>|<port>|<ipVersion>|<networkID>|<longAddressByte1>|<longAddressByte2>|<longAddressByte3>|<longAddressByte4>|<longAddressByte5>|<addressingMode>|<longTag>

All names in the chevrons identify the attribute of a HARTDevice node in the scan result document.

```
<?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:FDTHART_ExtendedIdentSchema.xml"
                        xmlns:hartdevice="x-schema:FDTHART_ExtendedDeviceTypeIdentSchema.xml"
                        xmlns:hartscan="x-schema:FDTHART_ExtendedScanIdentSchema.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">
```