IEC TR 62453-51-150

Edition 1.0 2017-06

TECHNICAL REPORT

colour inside

Field device tool (FDT) interface specification – Part 51-150: Communication implementation for common object model – IEC 61784 CPF 15

IEC TR 62453-51-150:2017-06(en)

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FIELD DEVICE TOOL (FDT) INTERFACE SPECIFICATION –

Part 51-150: Communication implementation for common object model – IEC 61784 CPF 15

FOREWORD

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IEC TR 62453-51-150, 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 62453-515 published in 2009. This edition constitutes a technical revision. The main changes consist in updates of the XML schemas.

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 62453-315.

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- withdrawn,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.

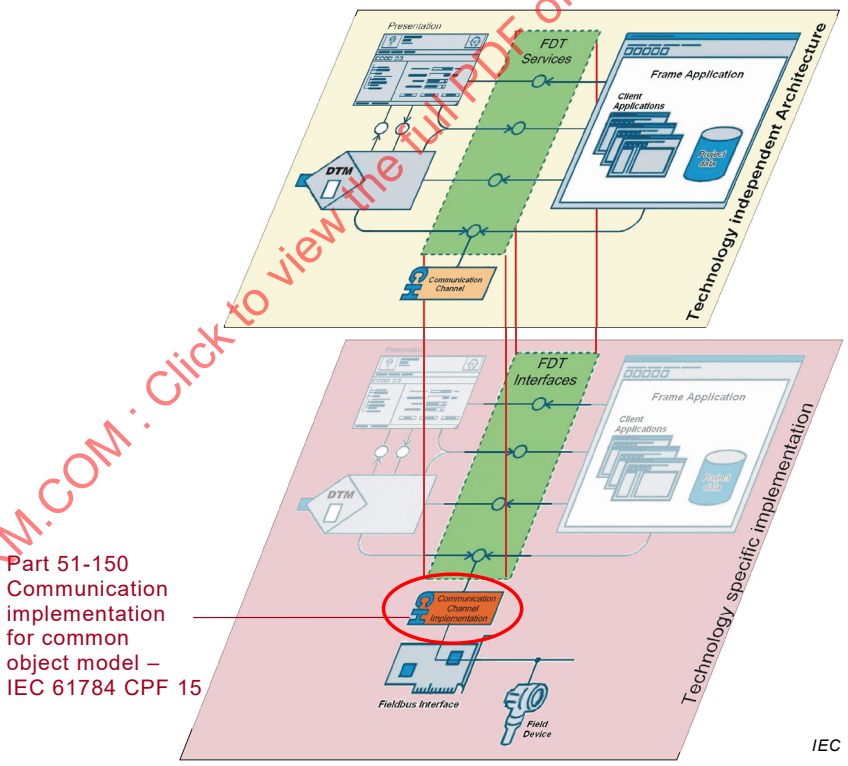

Figure 1 – Part 51-150 of the IEC 62453 series

FIELD DEVICE TOOL (FDT) INTERFACE SPECIFICATION –

Part 51-150: Communication implementation for common object model – IEC 61784 CPF 15

1 Scope

This part of the IEC 62453-51-xy series, which is a Technical Report, provides information for integrating IEC 61784-2 CPF 15 (Modbus TCP®) and Modbus Serial Line®[1] protocol support into FDT systems based on COM implementation. This part is to be used in conjunction with IEC TR 62453-41.

NOTE This part of IEC 62453 only specifies the mapping of Modbus parameters to FDT data types. For restrictions of protocol specific parameters concerning allowed values and concerning limitations of arrays used in the definition of FDT data types, refer to IEC 61158-5-15 and the MODBUS Application Protocol Specification.

This part of IEC 62453 specifies the implementation of communication and other services based on IEC 62453-315.

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 61131-3, *Programmable controllers – Part 3: Programming languages*

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

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

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 62453-315:2009, *Field device tool (FDT) interface specification – Part 315: Communication profile integration – IEC 61784 CPF 15*
IEC 62453-315:2009/AMD1:2016

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[1] Modbus is the trademark of Schneider Automation Inc. It is registered in the United States of America. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the trademark holder or any of its products. Compliance to this profile does not require use of the trademark Modbus. Use of the trademark Modbus requires permission from Schneider Automation Inc.

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 62453-315 apply.

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

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

3.2 Symbols and abbreviated terms

For the purposes of this document, the symbols and abbreviations given in IEC 62453-1, IEC 62453-2, IEC 62453-315, 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 15 protocol is identified by the attribute definition busCategory as specified in IEC 62453-315 (protocol identifiers).

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 62453-315.

6 Protocol specific usage of general data types

Table 1 shows how general data types are used with IEC 61784 CPF 15 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 62453-315.
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.

8 Network management data types

8.1 General

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

- IDtmParameter:GetParameters
- IDtmParameter:SetParameters

8.2 Modbus device address – FDTModbusAddressSchema

The address of a Modbus device is available at the element <BusInformation/UserdefinedBus>.

```
<?xml version="1.0"?>
<Schema name="FDTModbusAddressSchema" xmlns="urn:schemas-microsoft-com:xml-data" xmlns:dt="urn:schemas-microsoft-com:datatypes" xmlns:fdt="x-schema:FDTDataTypesSchema.xml">

<!-- Address schema for Modbus protocol V1.0 -->
<!-- This additional schema describes the different methods of addressing for Modbus TCP and Modbus Serial Line Devices -->
        <AttributeType name = "schemaVersion" dt:type = "number" default = "1.0"/>

        <!--Definition of attributes for Modbus addressing-->
        <!-- Slave address for Modbus Serial Line -->
        <AttributeType name="slaveAddress" dt:type="ui1"/>
        <!-- IP address for Modbus TCP -->
        <AttributeType name="tcpAddress" dt:type="string"/>
        <!-- TCP Port for Modbus TCP (default 502) -->
        <AttributeType name="tcpPort" dt:type="ui2" default = "502"/>

        <ElementType name="ModbusTCP" content="mixed" model="closed">
                <attribute type="fdt:nodeId" required="no"/>
                <attribute type="tcpAddress" required="yes"/>
                <attribute type="tcpPort" required="no"/>
                <attribute type="slaveAddress" required="no"/>
        </ElementType>
```

```
        <ElementType name="ModbusSerial" content="mixed" model="closed">
                <attribute type="fdt:nodeId" required="no"/>
                <attribute type="slaveAddress" required="yes"/>
        </ElementType>
</Schema>
```

9 Communication data types – FDTModbusCommunicationSchema

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

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

<!--FDT communication schema for Modbus protocol V1.0-->
<!--This schema describes all Modbus services which are defined in the Modbus Application Protocol Specification V1.1a from 4 June 2004 -->
<!--Due to the ongoing standardisation process in the CIA Group to specify the encapsulation of the CanOpen protocol in Modbus -->
<!--it was abstained to describe the Modbus service 0x2B/0x0D  -->

<Schema name = "FDTModbusCommunicationSchema"
    xmlns = "urn:schemas-microsoft-com:xml-data"
    xmlns:dt = "urn:schemas-microsoft-com:datatypes"
    xmlns:fdt = "x-schema:FDTDataTypesSchema.xml"
    xmlns:mb = "x-schema:FDTModbusAddressSchema.xml">

    <AttributeType name = "schemaVersion" dt:type = "number" default = "1.0"/>
    <AttributeType name = "communicationReference" dt:type = "uuid"/>


    <!--Modbus protocol parameters-->

    <!--ModbusException response-->
    <AttributeType name = "modbusService" dt:type = "enumeration" dt:values = "ReadCoils ReadDiscreteInputs ReadHoldingRegisters ReadInputRegisters WriteSingleCoil WriteSingleRegister ReadExceptionStatus Diagnostics GetCommEventCounter GetCommEventLog WriteMultipleCoils WriteMultipleRegisters ReportSlaveID ReadFileRecord WriteFileRecord MaskWriteRegister ReadWriteRegisters ReadFifoQueue EncapsulatedInterfaceTransport ReadDeviceIdentification PrivateModbus"/>
    <AttributeType name = "modbusExceptionCode" dt:type = "bin.hex" dt:minLength = "1"/>

    <!--Read/Write Data attributes-->
    <AttributeType name = "outputAddress" dt:type = "ui2"/>
    <AttributeType name = "startAddress" dt:type = "ui2"/>
    <AttributeType name = "quantity" dt:type = "ui2"/>
    <AttributeType name = "multipleCoilValues" dt:type = "string" dt:minLength = "1" dt:maxLength = "2000"/>
    <AttributeType name = "discreteInputsStatus" dt:type = "string" dt:minLength = "1" dt:maxLength = "2000"/>
    <AttributeType name = "registerValues" dt:type = "bin.hex" dt:minLength = "2" dt:maxLength = "250"/>
    <AttributeType name = "singleCoilValue" dt:type = "boolean"/>
    <AttributeType name = "singleRegister" dt:type = "bin.hex" dt:maxLength = "2" dt:minLength = "2"/>
    <!-- Diagnostic services attributes-->
    <AttributeType name = "exceptionStatus" dt:type = "bin.hex" dt:maxLength = "1" dt:minLength = "1"/>
    <AttributeType name = "commStatus" dt:type = "bin.hex" dt:maxLength = "2" dt:minLength = "2"/>
    <AttributeType name = "diagnosticsSubFct" dt:type = "bin.hex" dt:maxLength = "2" dt:minLength = "2"/>
    <AttributeType name = "diagnosticsData" dt:type = "bin.hex" dt:maxLength = "250" dt:minLength = "2"/>
    <AttributeType name = "data" dt:type = "bin.hex"/>
    <AttributeType name = "eventCount" dt:type = "bin.hex" dt:maxLength = "2" dt:minLength = "2"/>
    <AttributeType name = "messageCount" dt:type = "bin.hex" dt:maxLength = "2" dt:minLength = "2"/>
    <AttributeType name = "events" dt:type = "bin.hex"/>
    <!-- Read/Write File Record attributes-->
    <AttributeType name = "referenceType" dt:type = "bin.hex" dt:maxLength = "1" dt:minLength = "1"/>
    <AttributeType name = "fileNumber" dt:type = "bin.hex" dt:maxLength = "2" dt:minLength = "2"/>
    <AttributeType name = "recordNumber" dt:type = "bin.hex" dt:maxLength = "2" dt:minLength = "2"/>
    <AttributeType name = "recordData" dt:type = "bin.hex" dt:minLength = "2"/>
    <!-- Mask Write Register attributes-->
    <AttributeType name = "referenceAddress" dt:type = "ui2"/>
    <AttributeType name = "andMask" dt:type = "bin.hex" dt:maxLength = "2" dt:minLength = "2"/>
    <AttributeType name = "orMask" dt:type = "bin.hex" dt:maxLength = "2" dt:minLength = "2"/>
    <!-- Read/Write Registers attributes-->
    <AttributeType name = "readStartAddress" dt:type = "ui2"/>
    <AttributeType name = "readRegisterValues" dt:type = "bin.hex" dt:minLength = "2" dt:maxLength = "250"/>
    <AttributeType name = "readQuantity" dt:type = "ui2"/>
    <AttributeType name = "writeStartAddress" dt:type = "ui2"/>
    <AttributeType name = "writeRegisterValues" dt:type = "bin.hex" dt:minLength = "2" dt:maxLength = "242"/>
    <!-- Read FIFO Queue attributes -->
    <AttributeType name = "fifoPointerAddress" dt:type = "ui2"/>
```

```
<AttributeType name = "fifoRegisterValues" dt:type = "bin.hex" dt:minLength = "2" dt:maxLength = "62"/>
<!-- Encapsulated Interface Transport attributes -->
<AttributeType name = "meiType" dt:type = "bin.hex" dt:maxLength = "1" dt:minLength = "1"/>
<AttributeType name = "meiData" dt:type = "bin.hex" dt:minLength = "1" dt:maxLength = "251"/>
<!-- Device identification attributes-->
<AttributeType name = "readDeviceIdCode" dt:type = "ui1"/>
<AttributeType name = "objectId" dt:type = "bin.hex" dt:minLength = "1" dt:maxLength =" 1"/>
<AttributeType name = "conformityLevel" dt:type = "bin.hex" dt:maxLength = "1" dt:minLength = "1"/>
<AttributeType name = "moreFollows" dt:type = "boolean"/>
<AttributeType name = "nextObjectId" dt:type = "bin.hex" dt:minLength = "1" dt:maxLength =" 1"/>
<AttributeType name = "numberOfObjects" dt:type = "ui1"/>
<AttributeType name = "objectValue" dt:type = "bin.hex" dt:minLength = "1" dt:maxLength = "244"/>
<!-- Private Request attributes-->
<AttributeType name = "privateRequest" dt:type = "bin.hex"/>
<AttributeType name = "privateResponse" dt:type = "bin.hex"/>


<ElementType name = "ConnectRequest" content = "eltOnly"  model = "closed">
    <attribute type="fdt:systemTag" required="yes"/>
    <group order = "one" maxOccurs="1" minOccurs="1">
        <element type = "mb:ModbusSerial"/>
        <element type = "mb:ModbusTCP"/>
    </group>
</ElementType>

<ElementType name = "ConnectResponse" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
</ElementType>

<ElementType name = "DisconnectRequest" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
</ElementType>

<ElementType name = "DisconnectResponse" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
</ElementType>

<ElementType name="Abort" content="empty" model="closed">
    <attribute type="communicationReference" required="no"/>
</ElementType>

<!--Modbus Exception response-->

<ElementType name = "ModbusExceptionRsp" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
    <!--Applied Modbus service, which failed-->
    <attribute type = "modbusService" required = "yes"/>
    <!-- Modbus Exception code-->
    <attribute type = "modbusExceptionCode" required = "yes"/>
</ElementType>


<!--Definition of Modbus services-->


<!-- 0x01 Read Coils -->

<ElementType name = "ReadCoilsReq" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
    <!-- Starting address: 0x0000 to 0xFFFF (2 bytes) -->
    <attribute type = "startAddress" required = "yes"/>
    <!--Quantity of coils: 0x0001 to 0x07D0 (2 bytes) -->
    <attribute type = "quantity" required = "yes"/>
</ElementType>

<ElementType name = "ReadCoilsRsp" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
    <!-- Coil status: ASCII string with each coil state coded in one character ("1"==TRUE; "0"==FALSE) -->
    <attribute type = "multipleCoilValues" required = "yes"/>
</ElementType>


<!-- 0x02 Read Discrete Inputs -->

<ElementType name = "ReadDiscreteInputsReq" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
    <!-- Starting address: 0x0000 to 0xFFFF (2 bytes) -->
```

```
        <attribute type = "startAddress" required = "yes"/>
        <!-- Quantity of Inputs:  0x0001 to 0x07D0 (2 bytes)  -->
        <attribute type = "quantity" required = "yes"/>
    </ElementType>

    <ElementType name = "ReadDiscreteInputsRsp" content = "empty" model = "closed">
        <attribute type = "communicationReference" required = "yes"/>
        <!-- Input status: ASCII string with each discrete input state coded in one character ("1"==TRUE; "0"==FALSE) -->
        <attribute type = "discreteInputsStatus" required = "yes"/>
    </ElementType>

    <!-- 0x03 Read Holding Registers -->

    <ElementType name = "ReadHoldingRegistersReq" content = "empty" model = "closed">
        <attribute type = "communicationReference" required = "yes"/>
        <!-- Starting address:  0x0000 to 0xFFFF (2 bytes) -->
        <attribute type = "startAddress" required = "yes"/>
        <!-- Quantity of registers: 0x0001 to 0x007D (2 bytes) -->
        <attribute type = "quantity" required = "yes"/>
    </ElementType>

    <ElementType name = "ReadHoldingRegistersRsp" content = "empty" model = "closed">
        <attribute type = "communicationReference" required = "yes"/>
        <!-- Register value: read holding register values -->
        <attribute type = "registerValues" required = "yes"/>
    </ElementType>


    <!-- 0x04 Read Input Registers -->

    <ElementType name = "ReadInputRegistersReq" content = "empty" model = "closed">
        <attribute type = "communicationReference" required = "yes"/>
        <!-- Starting address: 0x0000 to 0xFFFF (2 bytes)-->
        <attribute type = "startAddress" required = "yes"/>
        <!-- Quantity of Input registers: 0x0001 to 0x007D (2 bytes) -->
        <attribute type = "quantity" required = "yes"/>
    </ElementType>

    <ElementType name = "ReadInputRegistersRsp" content = "empty" model = "closed">
        <attribute type = "communicationReference" required = "yes"/>
        <!-- Input registers: read input register values -->
        <attribute type = "registerValues" required = "yes"/>
    </ElementType>


    <!-- 0x05 Write Single Coil -->

    <ElementType name = "WriteSingleCoilReq" content = "empty" model = "closed">
        <attribute type = "communicationReference" required = "yes"/>
        <!-- Output address: 0x0000 to 0xFFFF (2 bytes) -->
        <attribute type = "outputAddress" required = "yes"/>
        <!-- Output value: boolean (1="true", 0=="false") -->
        <attribute type = "singleCoilValue" required = "yes"/>
    </ElementType>

    <ElementType name = "WriteSingleCoilRsp" content = "empty" model = "closed">
        <attribute type = "communicationReference" required = "yes"/>
    </ElementType>


    <!-- 0x06 Write Single Register -->

    <ElementType name = "WriteSingleRegisterReq" content = "empty" model = "closed">
        <attribute type = "communicationReference" required = "yes"/>
        <!-- Register address: 0x0000 to 0xFFFF (2 bytes)  -->
        <attribute type = "outputAddress" required = "yes"/>
        <!-- Register value: 0x0000 to 0xFFFF (2 bytes) -->
        <attribute type = "singleRegister" required = "yes"/>
    </ElementType>

    <ElementType name = "WriteSingleRegisterRsp" content = "empty" model = "closed">
        <attribute type = "communicationReference" required = "yes"/>
    </ElementType>


    <!-- 0x07 Read Exception Status (serial line only!!) -->
```

```
<ElementType name = "ReadExceptionStatusReq" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
</ElementType>

<ElementType name = "ReadExceptionStatusRsp" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
    <!-- Output data: 0x00 to 0xFF (1 byte) -->
    <attribute type = "exceptionStatus" required = "yes"/>
</ElementType>


<!-- 0x08 Diagnostics (serial line only!!) -->

<ElementType name = "DiagnosticsReq" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
    <!-- Sub-function -->
    <attribute type = "diagnosticsSubFct" required = "yes"/>
    <!-- Data: Nx2 bytes -->
    <attribute type = "diagnosticsData" required = "yes"/>
</ElementType>

<ElementType name = "DiagnosticsRsp" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
    <!-- Sub-function -->
    <attribute type = "diagnosticsSubFct" required = "yes"/>
    <!-- Data: Nx2 bytes -->
    <attribute type = "diagnosticsData" required = "no"/>
</ElementType>


<!-- 0x0B Get Comm Event Counter (serial line only!!) -->

<ElementType name = "GetCommEventCounterReq" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
</ElementType>

<ElementType name = "GetCommEventCounterRsp" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
    <!-- Status:  0x0000 to 0xFFFF (2 bytes) -->
    <attribute type = "commStatus" required = "yes"/>
    <!-- Event count: 0x0000 to 0xFFFF (2 bytes) -->
    <attribute type = "eventCount" required = "yes"/>
</ElementType>


<!-- 0x0C Get Comm Event Log (serial line only!!) -->

<ElementType name = "GetCommEventLogReq" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
</ElementType>

<ElementType name = "GetCommEventLogRsp" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
    <!-- Status: 0x0000 to 0xFFFF (2 bytes) -->
    <attribute type = "commStatus" required = "yes"/>
    <!-- Event count: 0x0000 to 0xFFFF (2 bytes) -->
    <attribute type = "eventCount" required = "yes"/>
    <!-- Message count: 0x0000 to 0xFFFF (2 bytes) -->
    <attribute type = "messageCount" required = "yes"/>
    <!-- Events: (N-6) x 1 byte (2 bytes) -->
    <attribute type = "events" required = "no"/>
</ElementType>


<!-- 0x0F Write Multiple Coils -->

<ElementType name = "WriteMultipleCoilsReq" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
    <!-- Starting address: 0x0000 to 0xFFFF (2 bytes) -->
    <attribute type = "outputAddress" required = "yes"/>
    <!-- Outputs value: ASCII string with each coil state coded in one character ("1"==TRUE; "0"==FALSE) -->
    <attribute type = "multipleCoilValues" required = "yes"/>
</ElementType>

<ElementType name = "WriteMultipleCoilsRsp" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
</ElementType>
```

```
<!-- 0x10 Write Multiple Registers -->

<ElementType name = "WriteMultipleRegistersReq" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
    <!-- Starting address: 0x0000 to 0xFFFF (2 bytes) -->
    <attribute type = "outputAddress" required = "yes"/>
    <!--Register value:  register values to write -->
    <attribute type = "registerValues" required = "yes"/>
</ElementType>

<ElementType name = "WriteMultipleRegistersRsp" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
</ElementType>


<!-- 0x11 Report Slave ID (serial line only!!) -->

<ElementType name = "ReportSlaveIDReq" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
</ElementType>

<ElementType name = "ReportSlaveIDRsp" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
    <!-- data: This attribute contains the Slave ID, the Run Indicator Status and -->
    <!-- the additional device specific data -->
    <!-- in the same format and order as defined in the Modbus specification -->
    <attribute type = "data" required = "yes"/>
</ElementType>

<!-- 0x14/0x06 Read File Record -->

<!-- Definition of sub-request structure  -->

<ElementType name = "ReadFileSubRequest" content = "empty" model = "closed">
    <!-- Sub-request x. reference type: must be 0x06  (1 byte) -->
    <attribute type = "referenceType" default="06" required = "yes"/>
    <!-- Sub-request x. File Number: 0x0000 to 0xFFFF (2 bytes) -->
    <attribute type = "fileNumber" required = "yes"/>
    <!-- Sub-request x. Record Number: 0x0000 to 0x270F (2 bytes) -->
    <attribute type = "recordNumber" required = "yes"/>
    <!-- Sub-request x. Register Length: N= 2 bytes (number of registers = record length) -->
    <attribute type = "quantity" required = "yes"/>
</ElementType>

<!-- Definition of main request structure  -->

<ElementType name = "ReadFileRecordReq" content = "eltOnly"   model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
    <!-- Sub-request: see ReadFileSubRequest -->
    <element type= "ReadFileSubRequest" minOccurs="1" maxOccurs="*" />
</ElementType>

<!-- Definition of sub-response structure  -->

<ElementType name = "ReadFileSubResponse" content = "empty" model = "closed">
    <!-- Sub-request x. Record Data: Nx2 bytes -->
    <attribute type = "recordData" required = "yes"/>
</ElementType>

<!-- Definition of main response structure  -->

<ElementType name = "ReadFileRecordRsp" content = "eltOnly" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
    <!-- Sub-request: see ReadFileSubResponse -->
    <element type= "ReadFileSubResponse" minOccurs="1" maxOccurs="*" />
</ElementType>

<!-- 0x15/0x06 Write File Record -->

<!-- Definition of sub-request structure  -->

<ElementType name = "WriteFileSubRequest" content = "empty" model = "closed">
    <!-- Sub-request x. Reference Type: must be 0x06  (1 byte) -->
    <attribute type = "referenceType" default="06" required = "yes"/>
    <!-- Sub-request x. File Number: 0x0000 to 0xFFFF (2 bytes) -->
```

```
    <attribute type = "fileNumber" required = "yes"/>
    <!-- Sub-request x. Record Number: 0x0000 to 0x270F (2 bytes) -->
    <attribute type = "recordNumber" required = "yes"/>
    <!-- Sub-request x. Record Data: Nx2 bytes -->
    <attribute type = "recordData" required = "yes"/>
</ElementType>

<!-- Definition of main request structure  -->

<ElementType name = "WriteFileRecordReq" content = "eltOnly"   model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
    <!-- Sub-request: see WriteFileSubRequest -->
    <element type= "WriteFileSubRequest" minOccurs="1" maxOccurs="*"/>
</ElementType>

<!-- Definition of main response structure  -->

<ElementType name = "WriteFileRecordRsp" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
</ElementType>

<!-- 0x16 Mask Write Register -->

<ElementType name = "MaskWriteRegisterReq" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
    <!-- Reference address: 0x0000 to 0xFFFF (2 bytes)  -->
    <attribute type = "referenceAddress" required = "yes"/>
    <!-- AND_Mask: 0x0000 to 0xFFFF (2 bytes) -->
    <attribute type = "andMask" required = "yes"/>
    <!-- OR_Mask: 0x0000 to 0xFFFF (2 bytes) -->
    <attribute type = "orMask" required = "yes"/>
</ElementType>

<ElementType name = "MaskWriteRegisterRsp" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
</ElementType>

<!-- 0x17 Read/Write Registers -->

<ElementType name = "ReadWriteRegistersReq" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
    <!-- Read starting address: 0x0000 to 0xFFFF (2 bytes) -->
    <attribute type = "readStartAddress" required = "yes"/>
    <!-- Quantity to read: 0x0001 to 0x007D (2 bytes) -->
    <attribute type = "readQuantity" required = "yes"/>
    <!-- Write starting address: 0x0000 to 0xFFFF (2 bytes) -->
    <attribute type = "writeStartAddress" required = "yes"/>
    <!-- Write register values: register values to write -->
    <attribute type = "writeRegisterValues" required = "yes"/>
</ElementType>

<ElementType name = "ReadWriteRegistersRsp" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
    <!-- Read register values: read register values -->
    <attribute type = "readRegisterValues" required = "yes"/>
</ElementType>

<!-- 0x18 Read Fifo Queue -->

<ElementType name = "ReadFifoQueueReq" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
    <!-- FIFO pointer address: 0x0000 to 0xFFFF (2 bytes) -->
    <attribute type = "fifoPointerAddress" required = "yes"/>
</ElementType>

<ElementType name = "ReadFifoQueueRsp" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
    <!-- FIFO register values -->
    <attribute type = "fifoRegisterValues" required = "yes"/>
</ElementType>

<!-- 0x2B Encapsulated Interface Transport -->

<ElementType name = "EncapsulatedInterfaceTransportReq" content = "empty" model = "closed">
    <attribute type = "communicationReference" required = "yes"/>
    <!-- MEI type: (1 byte) -->
    <attribute type = "meiType" required = "yes"/>
```

```
        <!-- MEI type specific data: n bytes -->
        <attribute type = "meiData" required = "yes"/>
    </ElementType>

    <ElementType name = "EncapsulatedInterfaceTransportRsp" content = "empty" model = "closed">
        <attribute type = "communicationReference" required = "yes"/>
        <!-- MEI type: (1 byte) -->
        <attribute type = "meiType" required = "yes"/>
        <!-- MEI type specific data: n bytes -->
        <attribute type = "meiData" required = "yes"/>
    </ElementType>

    <!-- 0x2B/0x0E Read Device Identification -->

    <!-- Definition of identification object structure -->

    <ElementType name = "IdentificationObject" content = "empty" model = "closed">
        <!-- Object ID:  (1 byte) -->
        <attribute type = "objectId" required = "yes"/>
        <!-- Object Value -->
        <attribute type = "objectValue" required = "yes"/>
    </ElementType>

    <!-- Definition of main request structure  -->

    <ElementType name = "ReadDeviceIdentificationReq" content = "empty" model = "closed">
        <attribute type = "communicationReference" required = "yes"/>
        <!-- Read device ID code:  01 / 02/ 03 / 04 (1 byte) -->
        <attribute type = "readDeviceIdCode" required = "yes"/>
        <!-- Object ID: first object to read  (1 byte) -->
        <attribute type = "objectId" required = "yes"/>
    </ElementType>

    <!-- Definition of main response structure  -->

    <ElementType name = "ReadDeviceIdentificationRsp" content = "eltOnly" model = "closed">
        <attribute type = "communicationReference" required = "yes"/>
        <!-- Read device ID code: 01 / 02/ 03 / 04 (1 byte) -->
        <attribute type = "readDeviceIdCode" required = "yes"/>
        <!-- Conformity level: (1 byte) -->
        <attribute type = "conformityLevel" required = "yes"/>
        <!-- More follows: boolean (1="true", 0=="false") -->
        <attribute type = "moreFollows" required = "yes"/>
        <!-- Next object ID:  (1 byte)-->
        <attribute type = "nextObjectId" required = "yes"/>
        <!-- Number of objects: number of identification objects returned in the response (1 byte)-->
        <attribute type = "numberOfObjects" required = "yes"/>
        <!-- Identification object: see IdentificationObject -->
        <element type= "IdentificationObject" minOccurs="1" maxOccurs="*"/>
    </ElementType>

    <!-- Private Modbus Request -->

    <ElementType name = "PrivateModbusReq" content = "empty" model = "closed">
        <attribute type = "communicationReference" required = "yes"/>
        <!-- Private Modbus request coded as hexadecimal byte-array -->
        <attribute type = "privateRequest" required = "yes"/>
    </ElementType>

    <ElementType name = "PrivateModbusRsp" content = "empty" model = "closed">
        <attribute type = "communicationReference" required = "yes"/>
        <!-- Private Modbus response coded as hexadecimal byte-array -->
        <attribute type = "privateResponse" required = "yes"/>
    </ElementType>


    <!-- Unconfirmed Private Modbus Request -->

    <ElementType name = "UnconfirmedPrivateModbusReq" content = "empty" model = "closed">
        <attribute type = "communicationReference" required = "yes"/>
        <!-- Private Modbus request coded as hexadecimal byte-array -->
        <attribute type = "privateRequest" required = "yes"/>
    </ElementType>

    <ElementType name = "UnconfirmedPrivateModbusRsp" content = "empty" model = "closed">
        <attribute type = "communicationReference" required = "yes"/>
    </ElementType>
```

```
<!-- Main FDT element -->

<ElementType name = "FDT" content = "eltOnly" order = "one" model = "closed">
    <attribute type = "schemaVersion"/>
    <attribute type = "fdt:nodeId"/>
    <group order = "one" maxOccurs="1" minOccurs="1">
        <element type = "ConnectRequest" />
        <element type = "ConnectResponse" />
        <element type = "DisconnectRequest" />
        <element type = "DisconnectResponse" />
        <element type = "Abort" />
        <element type = "ModbusExceptionRsp"/>
        <element type = "ReadCoilsReq"/>
        <element type = "ReadCoilsRsp"/>
        <element type = "ReadDiscreteInputsReq"/>
        <element type = "ReadDiscreteInputsRsp"/>
        <element type = "ReadHoldingRegistersReq"/>
        <element type = "ReadHoldingRegistersRsp"/>
        <element type = "ReadInputRegistersReq"/>
        <element type = "ReadInputRegistersRsp"/>
        <element type = "WriteSingleCoilReq"/>
        <element type = "WriteSingleCoilRsp"/>
        <element type = "WriteSingleRegisterReq"/>
        <element type = "WriteSingleRegisterRsp"/>
        <element type = "ReadExceptionStatusReq"/>
        <element type = "ReadExceptionStatusRsp"/>
        <element type = "DiagnosticsReq"/>
        <element type = "DiagnosticsRsp"/>
        <element type = "GetCommEventCounterReq"/>
        <element type = "GetCommEventCounterRsp"/>
        <element type = "GetCommEventLogReq"/>
        <element type = "GetCommEventLogRsp"/>
        <element type = "WriteMultipleCoilsReq"/>
        <element type = "WriteMultipleCoilsRsp"/>
        <element type = "WriteMultipleRegistersReq"/>
        <element type = "WriteMultipleRegistersRsp"/>
        <element type = "ReportSlaveIDReq"/>
        <element type = "ReportSlaveIDRsp"/>
        <element type = "ReadFileRecordReq"/>
        <element type = "ReadFileRecordRsp"/>
        <element type = "WriteFileRecordReq"/>
        <element type = "WriteFileRecordRsp"/>
        <element type = "MaskWriteRegisterReq"/>
        <element type = "MaskWriteRegisterRsp"/>
        <element type = "ReadWriteRegistersReq"/>
        <element type = "ReadWriteRegistersRsp"/>
        <element type = "ReadFifoQueueReq"/>
        <element type = "ReadFifoQueueRsp"/>
        <element type = "EncapsulatedInterfaceTransportReq"/>
        <element type = "EncapsulatedInterfaceTransportRsp"/>
        <element type = "ReadDeviceIdentificationReq"/>
        <element type = "ReadDeviceIdentificationRsp"/>
        <element type = "PrivateModbusReq"/>
        <element type = "PrivateModbusRsp"/>
        <element type = "UnconfirmedPrivateModbusReq"/>
        <element type = "UnconfirmedPrivateModbusRsp"/>
        <element type = "fdt:CommunicationError"/>
    </group>
</ElementType>

</Schema>
```


10 Channel parameter data types – FDTModbusChannelParameterSchema

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

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

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

```
<Schema name = "FDTModbusChannelParameterSchema"
      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">

    <!--FDT channel parameter schema V1.0 for Modbus protocol -->

    <!--Definition of Attributes-->

    <AttributeType name = "schemaVersion" dt:type = "number" default = "1.0"/>
    <AttributeType name = "address" dt:type = "ui2"/>
    <AttributeType name = "modbusDataTypes"  dt:type = "enumeration" dt:values = "coil discreteInput holdingRegister
inputRegister"/>
    <AttributeType name = "quantity" dt:type = "ui2"/>
    <AttributeType name = "protectedByChannelAssignment" dt:type = "boolean"/>
    <AttributeType name = "frameApplicationTag" dt:type = "string"/>
    <AttributeType name = "scaleValue" dt:type = "string"/>
    <AttributeType name="statusChannel" dt:type="boolean"/>
    <AttributeType name="gatewayBusCategory" dt:type="uuid"/>

    <!--All elements of the enumeration represent data types specified in IEC 61131-3 -->
    <AttributeType name = "iecDataType"  dt:type = "enumeration" dt:values = "BOOL SINT INT DINT LINT USINT UINT
UDINT ULINT REAL LREAL TIME DATE TimeOfDay DateAndTime STRING BYTE WORD DWORD LWORD WSTRING"/>

    <!--Definition of Elements-->

    <!--Definition of Modbus access data element-->

    <ElementType name = "ModbusAccessData" content = "empty" model = "closed">
        <attribute type = "fdt:nodeId"/>
        <!-- Starting address of the discrete input/coil/register -->
        <attribute type = "address" required = "yes"/>
        <!-- Type of data to be accessed -->
        <attribute type = "modbusDataTypes" required = "yes"/>
        <!-- Number of discrete inputs/coils/registers to be accessed -->
        <attribute type = "quantity" required = "yes"/>
        <!-- Access right for reading the Modbus data -->
        <attribute type="fdt:readAccess" required="no"/>
        <!-- Access right forwriting the Modbus data -->
        <attribute type="fdt:writeAccess" required="no"/>
    </ElementType>

    <!--Definition of UnitScaling element-->
    <ElementType name = "UnitScaling" content = "empty" model = "closed">
        <attribute type = "scaleValue" required = "yes"/>
    </ElementType>

    <ElementType name = "FDTChannel" content = "eltOnly" order = "seq" model = "closed">

        <attribute type = "fdt:nodeId"/>
        <!-- Unique identifier for a device, module or channel -->
        <attribute type = "fdt:tag" required = "yes"/>
        <!-- Unique identifier for an element within the device namespace -->
        <attribute type = "fdt:id" required = "yes"/>
        <!-- Human readable description within the context of a element -->
        <attribute type = "fdt:descriptor"/>
        <!-- TRUE if the channels is set to read only by the Frame Application -->
        <attribute type = "protectedByChannelAssignment" required = "yes"/>
        <!-- Standard FDT data type -->
        <attribute type = "fdt:dataType" required = "yes"/>
        <!-- Standard IEC 61131-3 data types -->
        <attribute type = "iecDataType" required = "no"/>
        <!-- Specifies a signal as input or output -->
        <attribute type = "fdt:signalType" required = "yes"/>
        <!-- Frame Application specific tag used for identification and navigation. -->
        <!-- The DTM should display this tag at channel specific user interfaces -->
        <attribute type = "frameApplicationTag"/>
        <!-- The appearance and the functionality of a DTM user interface is controlled by the  -->
        <!-- entry of the element applicationId, functionId, and operationPhase -->
        <attribute type = "appId:applicationId"/>
        <!-- TODO SemanticIDs need to be defined  -->
        <element type = "fdt:SemanticInformation" minOccurs = "0" maxOccurs = "*"/>
        <!-- Collection of EnumerationEntry   -->
        <element type = "fdt:BitEnumeratorEntries" minOccurs = "0" maxOccurs = "1"/>
        <!-- Enumeration element   -->
```

```
        <element type = "fdt:EnumeratorEntries" minOccurs = "0" maxOccurs = "1"/>
        <!-- Current unit and the collection of possible units of a process variable  -->
        <element type = "fdt:Unit" minOccurs = "0" maxOccurs = "1"/>
        <!-- scale value for the grapical representation of the process value -->
        <element type = "UnitScaling" minOccurs = "0" maxOccurs = "1"/>
        <!-- Address information needed to directly access the process data in the target device via Modbus  -->
        <element type = "ModbusAccessData" minOccurs = "0" maxOccurs = "1"/>
        <!-- Collection of alarms specified in FDT  -->
        <element type="fdt:Alarms" minOccurs="0" maxOccurs="1"/>
        <!-- Collection of ranges specified in FDT, which describe the valid range of a process value  -->
        <element type="fdt:Ranges" minOccurs="0" maxOccurs="1"/>
        <!-- Deadband is the amount of value changes that triggers for example new trend values.-->
        <element type = "fdt:Deadband" minOccurs = "0" maxOccurs = "1"/>
        <!-- Describes a substitute value which is used in combination of the behavior of disturbed channel values -->
        <element type="fdt:SubstituteValue" minOccurs="0" maxOccurs="1"/>
        <!-- should be used if the data type is structured -->
        <element type = "fdt:StructuredElements" minOccurs = "0" maxOccurs = "1"/>
    </ElementType>

    <ElementType name = "FDTChannelType" content = "eltOnly" order = "seq" model = "closed">
        <attribute type = "fdt:nodeId"/>
        <element type = "fdt:VersionInformation"/>
        <!-- Unique identifier for a supported bus type like Profibus or HART according to the FDT specific CATID -->
        <attribute type="gatewayBusCategory" required="no"/>
        <!-- TRUE if the channel is for status information only -->
        <attribute type="statusChannel" required="no"/>
    </ElementType>

    <ElementType name = "FDT" content = "eltOnly" order = "seq" model = "closed">
        <attribute type = "schemaVersion"/>
        <attribute type = "fdt:nodeId"/>
        <element type = "FDTChannelType" minOccurs="1" maxOccurs="1"/>
        <element type = "FDTChannel" minOccurs="1" maxOccurs="1"/>
    </ElementType>
</Schema>
```

11 Device identification

11.1 Device type identification data types – FDTModbusIdentSchema

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

<Schema name = "FDTModbusIdentSchema"
      xmlns = "urn:schemas-microsoft-com:xml-data"
      xmlns:dt = "urn:schemas-microsoft-com:datatypes">

    <!-- FDT ModbusIdent schema V1.0 for Modbus protocol -->
    <!-- The  FDT ModbusIdent schema contains the definition of the attributes for the optional Modbus identification objects
(Regular Category) -->
    <!-- The Modbus identification objects can be read with the standard Modbus service ReadDeviceIdentification -->

    <!--Definition of general Fdt attributes-->

    <AttributeType name = "schemaVersion" dt:type = "number" default = "1.0"/>
    <AttributeType name = "protocolName" dt:type = "string" default = "protocol_Modbus"/>
    <AttributeType name = "idDTMSupportLevel" dt:type = "enumeration" dt:values = "genericSupport profileSupport
blockspecificProfileSupport specificSupport identSupport"/>

    <!-- The Modbus identification objects are divided into two categories: -->

    <!-- - Basic category: -->
    <!--   Mandatory Modbus identification objects to required (mandatory) FDT identification elements -->

    <AttributeType name = "vendorName" dt:type = "string"/>
    <AttributeType name = "productCode" dt:type = "string"/>
    <AttributeType name = "majorMinorRevision" dt:type = "string"/>

    <!-- - Regular category: -->
    <!--   Optional Modbus identification objects to the optional FDT identification element IdValue-->
    <!--   Each Modbus identification object of the regular category is described with the following attributes -->

    <!-- name: Name of the Modbus identification object -->
```

```
    <AttributeType name = "name" dt:type = "enumeration" dt:values = "ProductName ModelName VendorURL
UserApplicationName"/>
    <!-- protocolSpecificName:Protocol specific name of the Modbus identification object (equals name) -->
    <AttributeType name = "protocolSpecificName" dt:type = "enumeration" dt:values = "ProductName ModelName VendorURL
UserApplicationName"/>
    <!-- value: Content of the Modbus identification object -->
    <AttributeType name = "value" dt:type = "string"/>


    <!-- Regular Expression attributes-->
    <AttributeType name = "match" dt:type = "string"/>
    <AttributeType name = "nomatch" dt:type = "string"/>


    <!-- Regular Expression element-->
    <ElementType name = "RegExpr" content = "empty" model = "closed">
        <attribute type = "match"/>
        <attribute type = "nomatch"/>
    </ElementType>
</Schema>
```

11.2 Topology scan data types – DTMModbusDeviceSchema

Used at IDtmEvents::OnScanResponse()

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

<Schema name="DTMModbusDeviceSchema"
    xmlns="urn:schemas-microsoft-com:xml-data"
    xmlns:fdt="x-schema:FDTDataTypesSchema.xml"
    xmlns:dt="urn:schemas-microsoft-com:datatypes"
    xmlns:mb = "x-schema:FDTModbusAddressSchema.xml">

    <!--FDT V1.2 device schema for Modbus protocol V1.0 -->
    <!-- The  FDT DTMModbusDevice schema defines the mapping of the Modbus identification objects -->
    <!-- to standard FDT identification elements for FDT V1.2 -->
    <!-- The Modbus identification objects can be read with the standard Modbus service ReadDeviceIdentification -->

    <!--Definition of general Fdt attributes-->
    <AttributeType name = "schemaVersion" dt:type = "number" default = "1.0"/>

    <!-- Definition of general FDT elements which contain the information about the applied protocol -->
    <!-- and the version of the protocol -->
    <AttributeType name = "protocolName" dt:type = "string" default = "protocol_Modbus"/>

    <!-- The mapping of Modbus identification objects to FDT identification elements is divided into two categories: -->

    <!-- - Basic category: -->
    <!--   Mapping of mandatory Modbus identification objects to required (mandatory) FDT identification elements -->

    <!--Modbus identification object VendorName -->
    <AttributeType name = "vendorName" dt:type = "string"/>
    <!--Modbus identification object ProductCode  -->
    <AttributeType name = "productCode" dt:type = "string"/>
    <!--Modbus identification object MajorMinorRevision  -->
    <AttributeType name = "majorMinorRevision" dt:type = "string"/>

    <!-- - Regular category: -->
    <!--   Mapping of optional Modbus identification objects to the optional FDT identification element IdValue-->
    <AttributeType name = "name" dt:type = "enumeration" dt:values = "ProductName ModelName VendorURL
UserApplicationName"/>
    <AttributeType name = "protocolSpecificName" dt:type = "enumeration" dt:values = "ProductName ModelName VendorURL
UserApplicationName"/>
    <AttributeType name = "value" dt:type = "string"/>

    <!-- Basic category: -->
    <!-- Mapping of Modbus identification elements required by the FDT DTMDeviceTypeIdent schema-->
    <!-- These elements represent all mandatory objects for Modbus device identification (basic category) -->

    <!--Modbus identification object VendorName is mapped to FDT element IdManufacturer -->
    <ElementType name = "IdManufacturer" content = "empty"  model = "closed">
        <attribute type = "vendorName" required="yes"/>
    </ElementType>
```

```
    <!--Modbus identification object ProductCode is mapped to FDT element IdTypeID -->
    <ElementType name = "IdTypeID" content = "empty"  model = "closed">
        <attribute type = "productCode" required="yes"/>
    </ElementType>

    <!--Modbus identification object MajorMinorRevision is mapped to FDT element IdSoftwareRevision -->
    <ElementType name = "IdSoftwareRevision" content = "empty"  model = "closed">
        <attribute type = "majorMinorRevision" required="yes"/>
    </ElementType>



    <!--Definition Modbus identification element not mandatory by the FDT DTMDeviceTypeIdent schema-->
    <!--This element represent all  objects for Modbus device identification (regular category) -->


    <ElementType name="IdValue" content="empty" model="closed">
        <attribute type="name" required="yes"/>
        <attribute type="value" required="yes"/>
        <attribute type="protocolSpecificName" required="yes"/>
    </ElementType>

    <ElementType name="IdValues" content="eltOnly" model="closed">
        <element type="IdValue" minOccurs="0" maxOccurs="*"/>
    </ElementType>

    <ElementType name="ModbusDevice" content="eltOnly" model="closed">
        <attribute type="fdt:nodeId" required="no"/>
        <attribute type="schemaVersion" required="no"/>
        <attribute type="protocolName" required="yes"/>
        <!-- Address information for Modbus TCP and Modbus Serial Line Devices  -->
        <group order = "one" maxOccurs="1" minOccurs="1">
            <element type = "mb:ModbusSerial"/>
            <element type = "mb:ModbusTCP"/>
        </group>
        <element type = "IdManufacturer" minOccurs="1" maxOccurs="1"/>
        <element type = "IdTypeID" minOccurs="1" maxOccurs="1"/>
        <element type = "IdSoftwareRevision" minOccurs="1" maxOccurs="1"/>
        <element type = "IdValues" minOccurs = "0" maxOccurs = "1"/>
    </ElementType>

</Schema>
```

11.3 Scan identification data types – FDTModbusScanIdentSchema

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

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

<Schema name="FDTModbusScanIdentSchema"
    xmlns="urn:schemas-microsoft-com:xml-data"
    xmlns:dt="urn:schemas-microsoft-com:datatypes"
    xmlns:modbusident="x-schema:FDTModbusIdentSchema.xml"
    xmlns:fdt="x-schema:FDTDataTypesSchema.xml"
    xmlns:mb = "x-schema:FDTModbusAddressSchema.xml">


    <!--FDT ScanIdent schema V1.0 for Modbus protocol -->
    <!-- The  FDT DeviceTypeIdent schema defines the mapping of the Modbus identification objects -->
    <!-- to standard FDT identification elements -->
    <!-- The Modbus identification objects can be read with the standard Modbus service ReadDeviceIdentification -->

    <!-- The mapping of Modbus identification objects to FDT identification elements is divided into two categories: -->

    <!-- - Basic category: -->
    <!--   Mapping of mandatory Modbus identification objects to required (mandatory) FDT identification elements -->

    <!-- - Regular category: -->
    <!--   Mapping of optional Modbus identification objects to the optional FDT identification element IdValue-->


    <!--Definition of general FDT 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 general FDT elements which contain the information about the applied protocol, -->
    <!-- the version of the protocol, the connection type and the address -->

    <ElementType name="IdBusProtocol" content="empty" model="closed">
        <attribute type = "modbusident:protocolName" required="yes"/>
    </ElementType>

    <ElementType name="IdAddress" content="eltOnly" model="closed">
        <!--Modbus specific addressing depending on connection type -->
        <group order = "one" maxOccurs="1" minOccurs="1">
            <element type = "mb:ModbusSerial"/>
            <element type = "mb:ModbusTCP"/>
        </group>
    </ElementType>


    <!-- Basic category: -->
    <!-- Mapping of Modbus identification elements required by the FDT DTMDeviceTypeIdent schema-->
    <!-- These elements represent all mandatory objects for Modbus device identification (basic category) -->

    <!--Modbus identification object VendorName is mapped to FDT element IdManufacturer -->
    <ElementType name="IdManufacturer" content="empty" model="closed">
        <attribute type = "modbusident:vendorName" required="yes"/>
    </ElementType>

    <!--Modbus identification object ProductCode is mapped to FDT element IdTypeID -->
    <ElementType name="IdTypeID" content="empty" model="closed">
        <attribute type = "modbusident:productCode"  required="yes"/>
    </ElementType>

    <!--Modbus identification object MajorMinorRevision is mapped to FDT element IdSoftwareRevision -->
    <ElementType name="IdSoftwareRevision" content="empty" model="closed">
        <attribute type = "modbusident:majorMinorRevision" required="yes"/>
    </ElementType>

    <!-- Regular category: -->
    <!-- Mapping of Modbus identification elements not required by the FDT DTMDeviceTypeIdent schema-->
    <!-- The information provided by each optional Modbus identification object (regular category) is mapped  -->
    <!-- to the standard FDT identification element IdValues, which may occur several times -->

    <!-- The following optional Modbus identification objects are supported: -->

    <!-- VendorUrl              Attribute name/Protocol specific name:"vendorUrl"              -->
    <!-- ProductName            Attribute name/Protocol specific name:"productName"            -->
    <!-- ModelName              Attribute name/Protocol specific name:"modelName"              -->
    <!-- UserApplicationName    Attribute name/Protocol specific name:"userApplicationName"    -->

    <ElementType name="IdValue" content="empty" model="closed">
        <attribute type="modbusident:name" required="yes"/>
        <attribute type="modbusident:value" required="yes"/>
        <attribute type="modbusident:protocolSpecificName" required="yes"/>
    </ElementType>

    <ElementType name="IdValues" content="eltOnly" model="closed">
        <element type="IdValue" minOccurs="0" maxOccurs="*"/>
    </ElementType>

    <!--FDT ScanIdentification element -->

    <ElementType name="ScanIdentification" content="eltOnly" model="closed">
        <attribute type="configuredState" required="no"/>
        <element type="fdt:CommunicationError" minOccurs="0" maxOccurs="1" />
        <element type="IdBusProtocol" minOccurs="1" maxOccurs="1"/>
        <element type="IdAddress" 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="IdValues" 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 – FDTModbusDeviceTypeIdentSchema

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

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

<Schema name = "FDTModbusDeviceTypeIdentSchema"
      xmlns = "urn:schemas-microsoft-com:xml-data"
      xmlns:dt = "urn:schemas-microsoft-com:datatypes"
      xmlns:modbusident = "x-schema:FDTModbusIdentSchema.xml"
      xmlns:fdt = "x-schema:FDTDataTypesSchema.xml">

    <!-- FDT DeviceTypeIdent schema V1.0 for Modbus protocol -->
    <!-- The  FDT DeviceTypeIdent schema defines the mapping of the Modbus identification objects -->
    <!-- to standard FDT identification elements -->
    <!-- The Modbus identification objects can be read with the standard Modbus service ReadDeviceIdentification -->

    <!-- The mapping of Modbus identification objects to FDT identification elements is divided into two categories: -->

    <!-- - Basic category: -->
    <!--   Mapping of mandatory Modbus identification objects to required (mandatory) FDT identification elements -->

    <!-- - Regular category: -->
    <!--   Mapping of optional Modbus identification objects to the optional FDT identification element IdValue-->


    <!-- Definition of general FDT attributes-->
    <AttributeType name = "schemaVersion" dt:type = "number" default = "1.0"/>

    <!-- Definition of general FDT elements which contain the information about the applied protocol -->
    <!-- and the version of the protocol -->

    <ElementType name = "IdBusProtocol" content = "empty"  model = "closed">
        <attribute type = "modbusident:protocolName" required="yes"/>
    </ElementType>

    <!-- Basic category: -->
    <!-- Mapping of Modbus identification elements required by the FDT DTMDeviceTypeIdent schema-->
    <!-- These elements represent all mandatory objects for Modbus device identification (basic category) -->

    <!--Modbus identification object VendorName is mapped to FDT element IdManufacturer -->
    <ElementType name = "IdManufacturer" content = "eltOnly"  model = "closed">
        <attribute type = "modbusident:vendorName" required="yes"/>
        <element type = "modbusident:RegExpr" minOccurs = "0" maxOccurs = "*"/>
    </ElementType>

    <!--Modbus identification object ProductCode is mapped to FDT element IdTypeID -->
    <ElementType name = "IdTypeID" content = "eltOnly"  model = "closed">
        <attribute type = "modbusident:productCode" required="yes"/>
        <element type = "modbusident:RegExpr" minOccurs = "0" maxOccurs = "*"/>
    </ElementType>

    <!--Modbus identification object MajorMinorRevision is mapped to FDT element IdSoftwareRevision -->
    <ElementType name = "IdSoftwareRevision" content = "eltOnly"  model = "closed">
        <attribute type = "modbusident:majorMinorRevision" required="yes"/>
        <element type = "modbusident:RegExpr" minOccurs = "0" maxOccurs = "*"/>
    </ElementType>


    <!-- Regular category: -->
    <!-- Mapping of Modbus identification elements not required by the FDT DTMDeviceTypeIdent schema-->
    <!-- The information provided by each optional Modbus identification object (regular category) is mapped  -->
    <!-- to the standard FDT identification element IdValues, which may occur several times -->
```

```
    <!-- The following optional Modbus identification objects are supported: -->

    <!-- VendorUrl              Attribute name/Protocol specific name:"vendorUrl"              -->
    <!-- ProductName            Attribute name/Protocol specific name:"productName"            -->
    <!-- ModelName              Attribute name/Protocol specific name:"modelName"              -->
    <!-- UserApplicationName    Attribute name/Protocol specific name:"userApplicationName"    -->


    <ElementType name="IdValue" content="eltOnly" model="closed">
        <attribute type="modbusident:name" required="yes"/>
        <attribute type="modbusident:value" required="no"/>
        <attribute type="modbusident:protocolSpecificName" required="yes"/>
        <element type="modbusident:RegExpr" minOccurs="0" maxOccurs="*"/>
    </ElementType>

    <ElementType name="IdValues" content="eltOnly" model="closed">
        <element type="IdValue" minOccurs="0" maxOccurs="*"/>
    </ElementType>

    <!--FDT DeviceIdentification element -->

    <ElementType name = "DeviceIdentification" content = "eltOnly" model = "closed">
        <attribute type = "modbusident:idDTMSupportLevel" required="yes"/>
        <element type = "IdBusProtocol" 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 = "IdValues" minOccurs = "0" maxOccurs = "1"/>
    </ElementType>

    <ElementType name = "DeviceIdentifications" content = "eltOnly" model = "closed">
        <element type = "DeviceIdentification" minOccurs = "1" maxOccurs = "*"/>
    </ElementType>

    <ElementType name = "FDT" content = "eltOnly" model = "closed">
        <element type = "DeviceIdentifications"/>
    </ElementType>

</Schema>
```

11.5 XSLT Transformation

```
<?xml version="1.0" encoding="UTF-8"?>
<!--FDT XSL transformation for Modbus protocol V1.0-->
<!--This XSL transformation defines the transformation of an XML document with Modbus specific parameters to a protocol
independent -->
<!--XML document as it is required in FDT for the device identification and the scan -->

<xsl:transform xmlns:xsl="http://www.w3.org/1999/XSL/Transform" version="1.0" 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:modbusdevice="x-
schema:FDTModbusDeviceTypeIdentSchema.xml" xmlns:modbusident="x-schema:FDTModbusIdentSchema.xml"
xmlns:modbusscan="x-schema:FDTModbusScanIdentSchema.xml" xmlns:mb="x-schema:FDTModbusAddressSchema.xml"
exclude-result-prefixes="str modbusdevice modbusident modbusscan mb">
    <!-- Definition of transformation output format -->
    <xsl:output method="xml" indent="no" encoding="UTF-8"/>
    <xsl:variable name="FileVersion" select="1.0"/>
    <!-- select root element FDT -->
    <xsl:template match="/">

            <!-- check if the XML document which shall be transfomed contains the information -->
            <!-- of a device identification or of a bus scan -->
            <xsl:apply-templates select="//modbusscan:ScanIdentifications"/>
            <xsl:apply-templates select="//modbusdevice:DeviceIdentifications"/>

    </xsl:template>
    <!-- the XML document contains the information for a device identification -->
    <xsl:template match="modbusdevice:DeviceIdentifications">

        <xsl:element name="devident:FDT">
            <xsl:element name="devident:DeviceIdentifications">
            <xsl:apply-templates select="modbusdevice:DeviceIdentification"/>
            </xsl:element>
```