ENGLISH

Using OPC UA Application Defined Information Models - Anybus® CompactCom™ IIoT Secure

APPLICATION NOTE

SCM-1202-182
Version 3.1
Publication date 2022-04-08

Box 4126
300 04 Halmstad, Sweden

info@hms.se

Table of Contents

This page is intentionally left blank.

1. Using OPC UA Application Defined Information Models

By default, the information model of the CompactCom IIoT module defines a CompactCom40DeviceType based on the OPC UA for devices DeviceType and presents asset information (product name, serial number, software version) and parameters (Application Data Instances, ADIs).

The default information model can be replaced by an application-defined information model created in an OPC UA modeler tool. The application-defined information model can be completely custom or based on existing companion specifications.

The information model is defined by a Nodeset2 XML file that can be generated by an OPC UA Modeler Tool. The finished Nodeset2 file is converted by a tool from HMS, 'Anybus OPC UA NodeSet Encoder' to a binary file that is downloaded to the file system of the Anybus CompactCom 40 IIoT Secure.

Variable nodes must be tied to ADIs in the host application. A separate namespace must be created for those nodes.

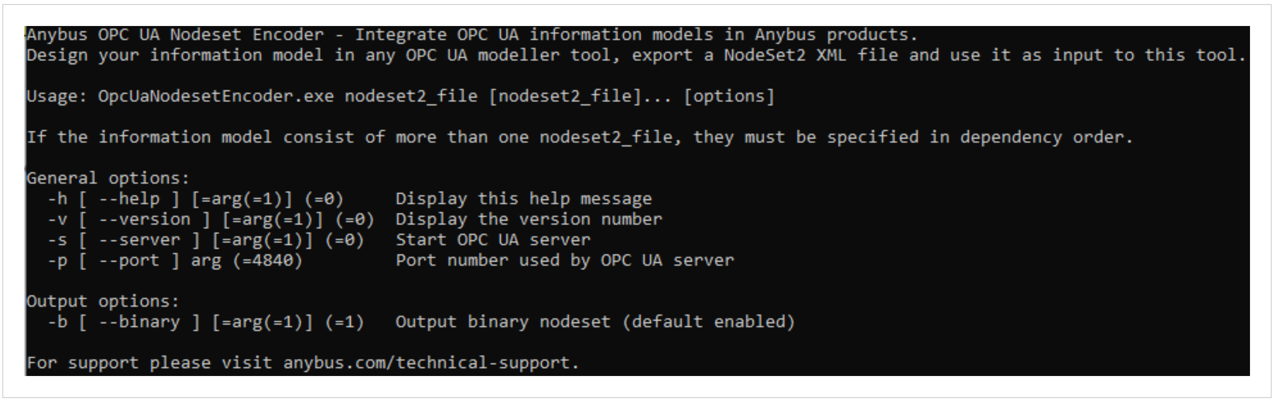
- OPC Unified Architecture Specifications can be downloaded here:
  https://opcfoundation.org/developer-tools/specifications-unified-architecture
- Existing Companion Specifications can be downloaded here:
  https://opcfoundation.org/developer-tools/specifications-opc-ua-information-models
- Information Model Nodesets based on different Companion Specifications can be downloaded here:
  https://github.com/OPCFoundation/UA-Nodeset
- UA Modeling Best Practices document:
  https://opcfoundation.org/wp-content/uploads/2020/09/OPC-11030-Whitepaper-UA-Modeling-Best-Practices-1.00.00.pdf

1.1. Anybus OPC UA NodeSet Encoder

The Anybus OPC UA NodeSet Encoder for Windows is a command-line tool used to convert the NodeSet2 XML file generated by the OPC UA Modeler Tool to a binary file used by the Anybus CompactCom 40 IIoT Secure.

The Anybus OPC UA NodeSet Encoder can also be used to simulate a server with the developed information model before downloading it to the Anybus CompactCom 40 IIoT Secure module.

The Anybus OPC UA NodeSet Encoder can be downloaded from the support pages for the Anybus CompactCom 40 IIoT Secure modules. https://anybus.com/support.


```
Anybus OPC UA Nodeset Encoder - Integrate OPC UA information models in Anybus products.
Design your information model in any OPC UA modeller tool, export a NodeSet2 XML file and use it as input to this tool.

Usage: OpcUaNodesetEncoder.exe nodeset2_file [nodeset2_file]... [options]

If the information model consist of more than one nodeset2_file, they must be specified in dependency order.

General options:
  -h [ --help ] [=arg(=1)] (=0)     Display this help message
  -v [ --version ] [=arg(=1)] (=0)  Display the version number
  -s [ --server ] [=arg(=1)] (=0)   Start OPC UA server
  -p [ --port ] arg (=4840)         Port number used by OPC UA server

Output options:
  -b [ --binary ] [=arg(=1)] (=1)   Output binary nodeset (default enabled)

For support please visit anybus.com/technical-support.
```

Figure 1. Command line options:

Example (generate files):

```
OpcUaNodesetEncoder.exe -b Opc.Ua.Robotics.NodeSet2.xml
MyCustomRobotNodeSet.xml
```

Example (simulate OPC UA server):

```
OpcUaNodesetEncoder.exe -s 1 -p 4840 Opc.Ua.Robotics.NodeSet2.xml
MyCustomRobotNodeSet.xml
```

NOTE
The mandatory namespace 0 (Opc.Ua.Di.NodeSet2.xml) will always be added automatically by the Anybus OPC UA NodeSet Encoder, and does not need to be explicitly added as an input.

1.2. From Idea to Running Application

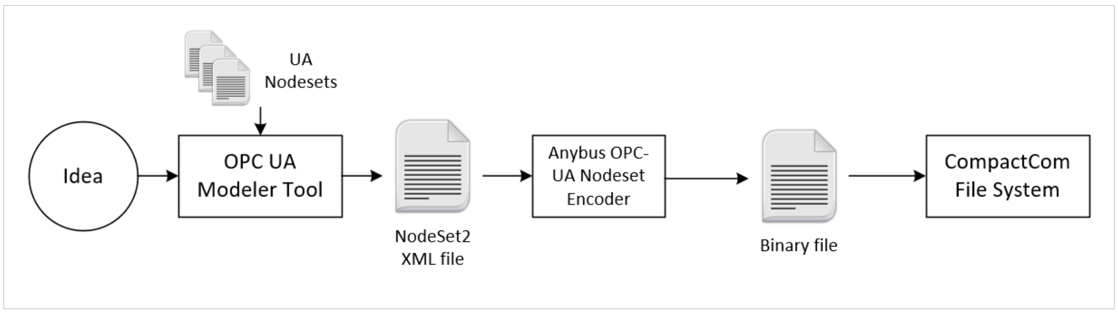


Figure 2. Overview

1. Model the device in an OPC UA Modeler Tool of your choice. The model can be based on Existing UA Nodesets, imported into the modeler tool. Variable nodes must be moved to a separate NameSpace named ‘urn:compactcom40:parameters’, and the node ID must be built up according to the following:

   Table 1. Node ID Encoding

Node ID	Description
0x01000000 - 0x01FFFFFF	The node IDs have the following encoding: 0x01MMMMNN • MMMM = ADI number • NN = ID of a node that models certain information of an ADI Table 2. NN Encoding

NN:	Description
0x00	Value variable nodes of the ADIs
0x01	Max value variable nodes of the ADIs
0x02	Min value variable nodes of the ADIs
0x03	Default value variable nodes of the ADIs
0x04	OptionSetValues property of OptionSetType (only exists for ADIs with BITS or BITx data types)
0x05	EnumStrings property of MultiStateDiscreteType (only exists for ADIs with ENUM data type)

2. Export the information model as a NodeSet2 XML file.
3. Run the ‘Anybus OPC UA NodeSet Encoder’ in a command window.

   NOTE
   If all nodesets used when modelling the information model are not included in the exported file, the included nodesets must be added as inputs when running the encoder. The files must be added in order, with the nodeset highest in the hierarchy first. See example below.

   Example (generate files):

```
OpcUaNodesetEncoder.exe -b 1 Opc.Ua.Robotics.NodeSet2.xml
MyCustomRobotNodeSet.xml
```

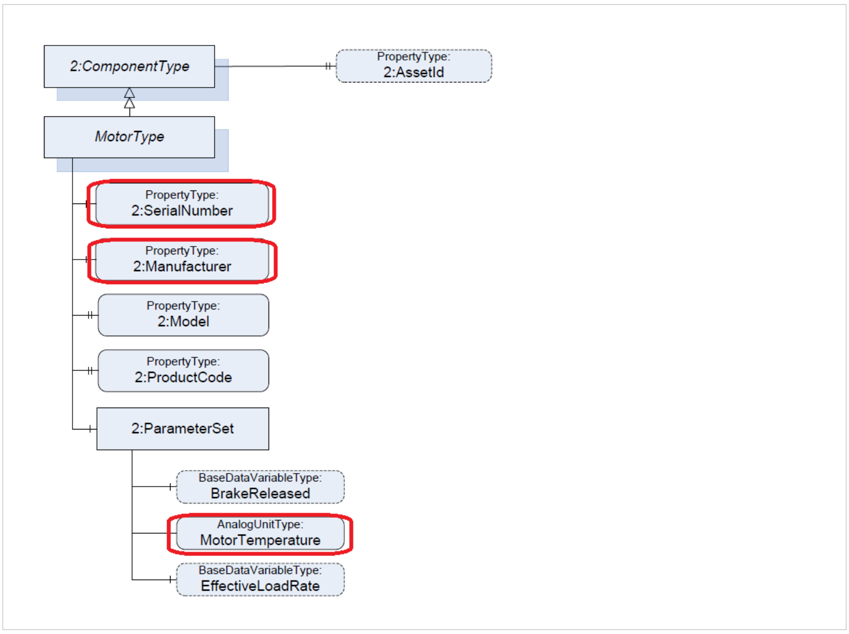
4. A binary file is generated by the Command Line Tool; binarynodeset.hiff.
5. In this step, the command line tool can be used to simulate the information model without downloading it to the Anybus CompactCom. Use the -s option to start the simulation.
   Example (simulate OPC UA server):

```
OpcUaNodesetEncoder.exe -s 1 -p 4840
Opc.Ua.Robotics.NodeSet2.xml MyCustomRobotNodeSet.xml
```

6. Download the binary file (binarynodeset.hiff) to the Anybus file system root by using WebDAV or directly from the host application by using the Anybus File System Interface Object (0Ah). The user account used when downloading the file via WebDAV must have access to the Anybus file system root.
   During development, admin mode can be convenient to grant access for all users to the Anybus file system root. Set attribute #7 in the Ethernet host object (F9h) to TRUE to enable admin mode.
7. Include the corresponding ADI list in the host application source code.
8. Reset and re-initialize the Anybus CompactCom 40 IIoT Secure. For the OPC UA server to be enabled with the downloaded nodeset, the OPC UA model, attribute #1 in the OPC UA Host Object (E3h), must be set to 2.
9. The application-defined information model is now running, and a Client can connect and exchange data with the host application.

2. Siemens OPC UA Modeling Editor Example

In this example, which is a simple example of the workflow and nowhere near a complete information model, the OPC UA for Robotics NodeSet is used, and a Motion Device System is created. The example is concentrating on the motor in a power train. One node is kept static (Manufacturer) and the value is set directly in the information model. Two nodes are variable (MotorTemperature and SerialNumber) and are connected to ADIs in the Anybus CompactCom host application.


2:ComponentType
PropertyType: 2:AssetId
MotorType
PropertyType: 2:SerialNumber
PropertyType: 2:Manufacturer
PropertyType: 2:Model
PropertyType: 2:ProductCode
2:ParameterSet
BaseDataVariableType: BrakeReleased
AnalogUnitType: MotorTemperature
BaseDataVariableType: EffectiveLoadRate

Companion specification: OPC 40010-1 - UA Companion Specification Part 1 for Robotics 1.00

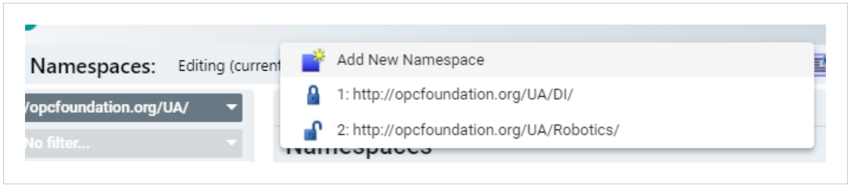
Start the Siemens OPC UA Modeling Editor and follow the workflow below.

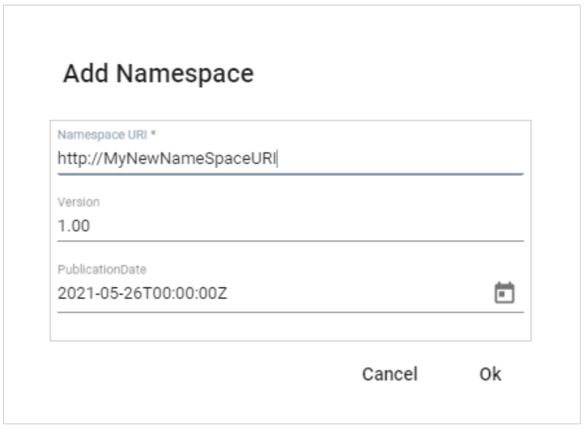
1. Import NodeSets.

   First, all related nodesets must be imported. Click the ‘Import XML’ button and browse to the required nodesets. For the Robotics nodeset the following XML-files must be imported:

   - Opc.Ua.Di.NodeSet2.xml
   - Opc.Ua.Robotics.NodeSet2.xml

2. Add a new NameSpace for your InformationModel. Click the drop-down with the text ‘Please add or choose a namespace’.




Add Namespace

Namespace URI *
http://MyNewNameSpaceURI

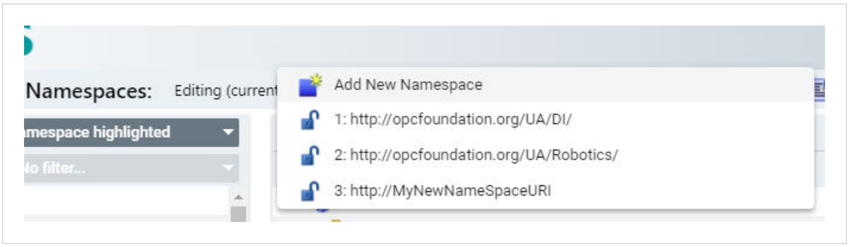
Version
1.00

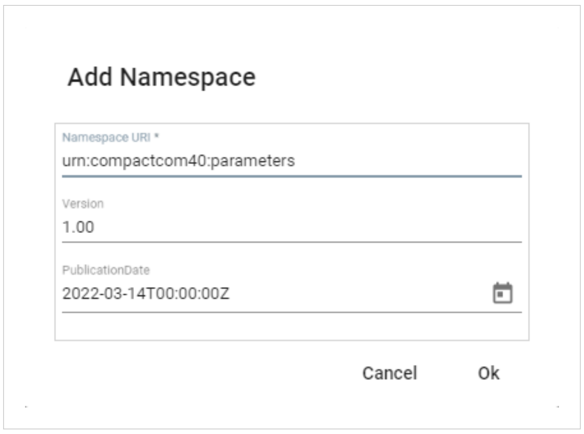
PublicationDate
2021-05-26T00:00:00Z

Cancel Ok

3. Add a new NameSpace for variable nodes to be connected to ADIs in the host application. Click the drop-down with the text ‘Please add or choose a namespace’.

IMPORTANT
This namespace must be named ‘urn:compactcom40:parameters’.


Namespaces:
Editing (current
mespace highlighted
No filter...
Add New Namespace
1: http://opcfoundation.org/UA/DI/
2: http://opcfoundation.org/UA/Robotics/
3: http://MyNewNameSpaceURI


Add Namespace

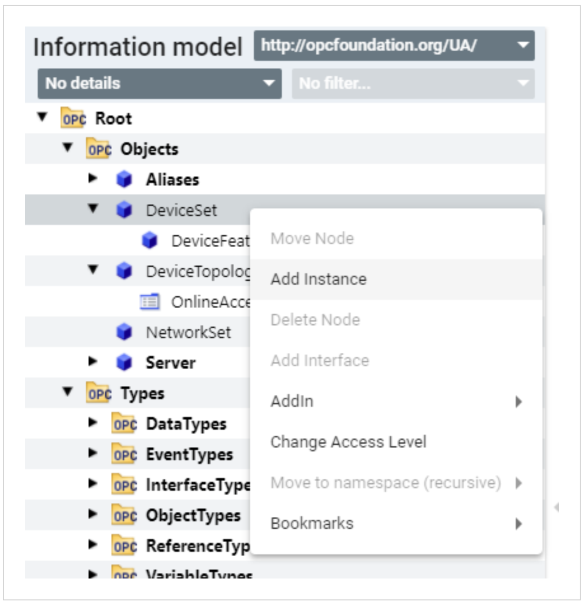
Namespace URI *
urn:compactcom40:parameters

Version
1.00

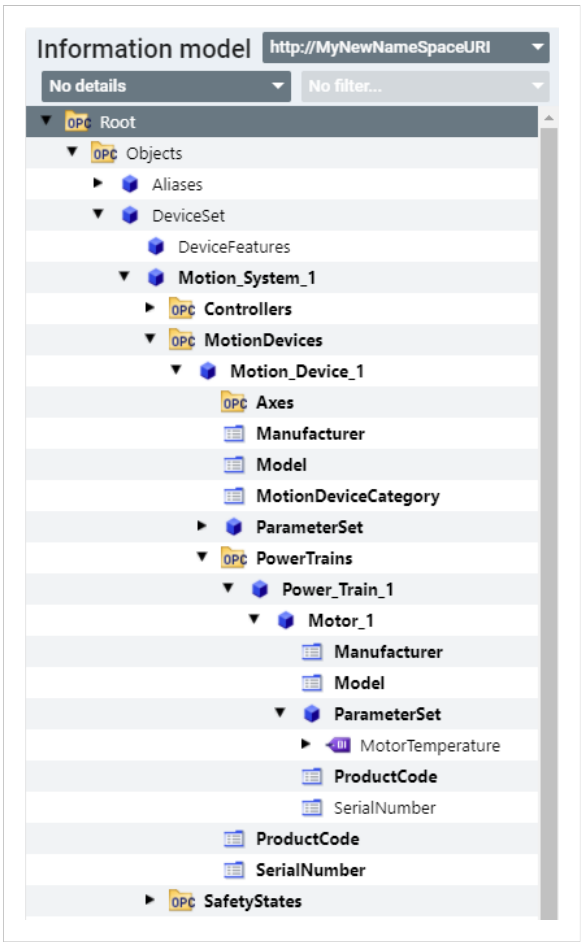
PublicationDate
2022-03-14T00:00:00Z

Cancel Ok

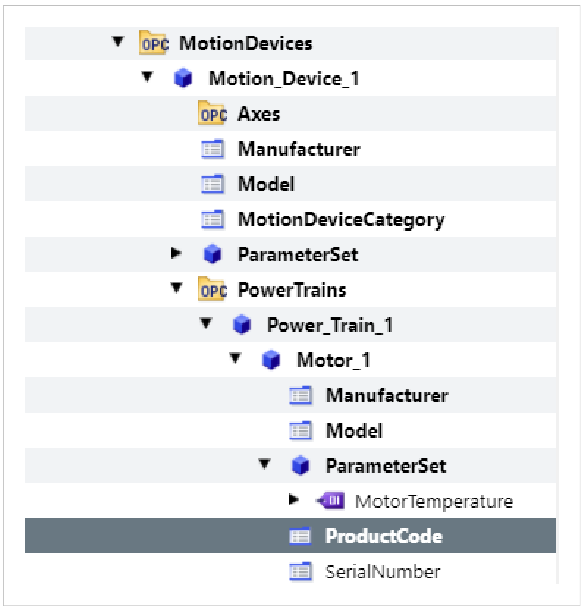
4. Create a Motion Device System in the http://MyNewNameSpaceURI namespace.
   A new instance is added by right-clicking ‘DeviceSet’ and selecting ‘Add Instance’.

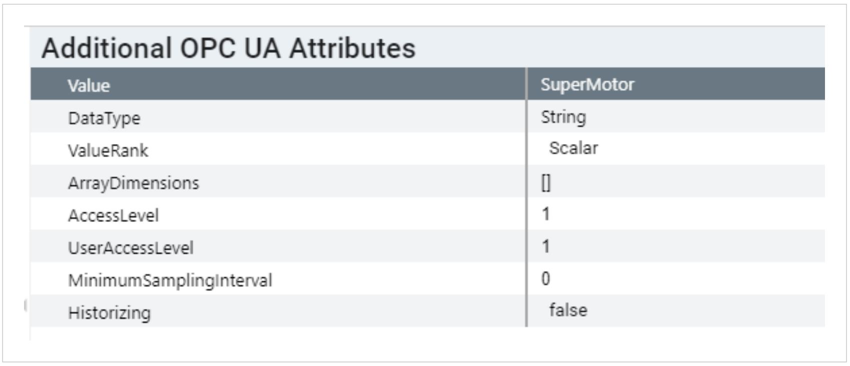


Add a motion system instance with a MotionDeviceSystemType. Under MotionDevices->PowerTrains, add a power train with a PowerTrainType. Now an instance with the MotorType is available, and the variables can be configured.
Now, the model will look something like this:



5. Configure the ProductCode with a static value (‘SuperMotor’ in this example).

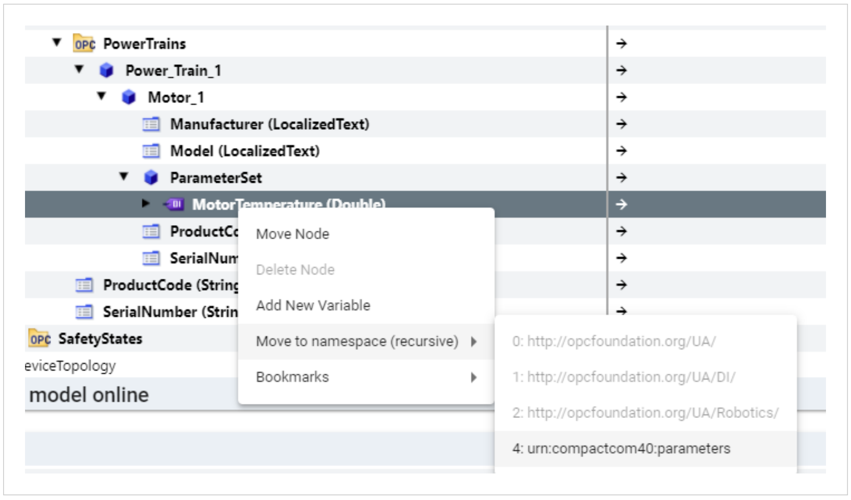




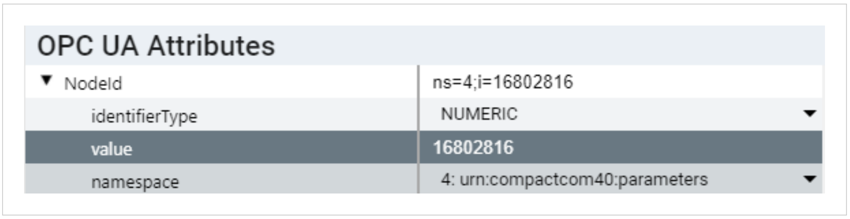
Additional OPC UA Attributes

Value	SuperMotor
DataType	String
ValueRank	Scalar
ArrayDimensions	[]
AccessLevel	1
UserAccessLevel	1
MinimumSamplingInterval	0
Historizing	false

6. Connect the MotorTemperature node to an ADI in the host application.
   Change namespace by right-clicking and select ‘Move to namespace’ and select the ‘urn:compactcom40:parameters’ namespace.


PowerTrains
Power_Train_1
Motor_1
Manufacturer (LocalizedText)
Model (LocalizedText)
ParameterSet
MotorTemperature (Double)
ProductC
SerialNum
ProductCode (String
SerialNumber (Strin
SafetyStates
eviceTopology
model online
Move Node
Delete Node
Add New Variable
Move to namespace (recursive)
Bookmarks
0: http://opcfoundation.org/UA/
1: http://opcfoundation.org/UA/DI/
2: http://opcfoundation.org/UA/Robotics/
4: urn:compactcom40:parameters

   Enter the Node ID.

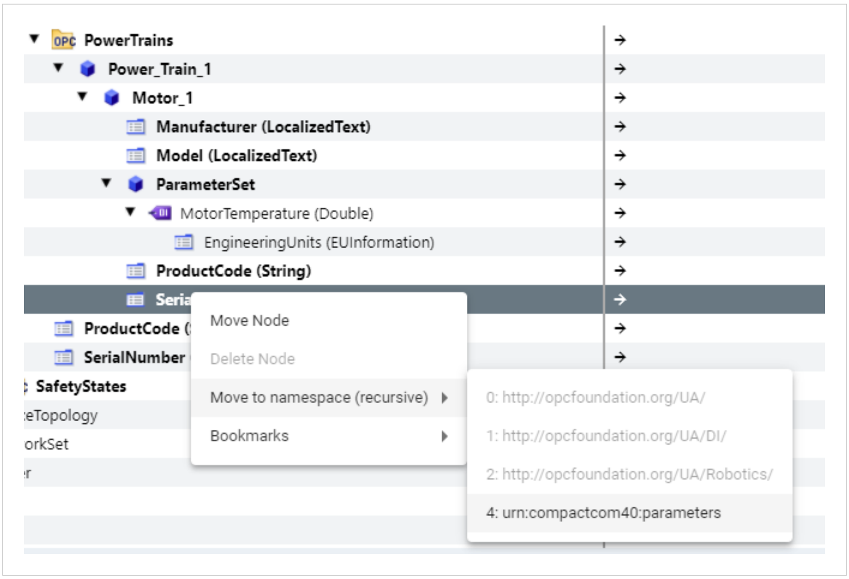


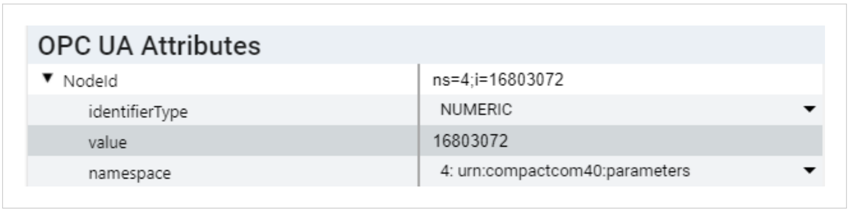
OPC UA Attributes

NodeId	ns=4;i=16802816
identifierType	NUMERIC
value	16802816
namespace	4: urn:compactcom40:parameters

   NodeID for the value of ADI number 100, 0x01006400 = 16802816.

7. Connect the SerialNumber node to an ADI in the host application.
   Change Namespace by right clicking and select ‘Move to namespace’ and select the ‘urn:compactcom40:parameters’ namespace.


PowerTrains
Power_Train_1
Motor_1
Manufacturer (LocalizedText)
Model (LocalizedText)
ParameterSet
MotorTemperature (Double)
EngineeringUnits (EUInformation)
ProductCode (String)
Seria
ProductCode (
SerialNumber
SafetyStates
eTopology
orkSet
Move Node
Delete Node
Move to namespace (recursive)
Bookmarks
0: http://opcfoundation.org/UA/
1: http://opcfoundation.org/UA/DI/
2: http://opcfoundation.org/UA/Robotics/
4: urn:compactcom40:parameters



OPC UA Attributes

NodeId	ns=4;i=16803072
identifierType	NUMERIC
value	16803072
namespace	4: urn:compactcom40:parameters

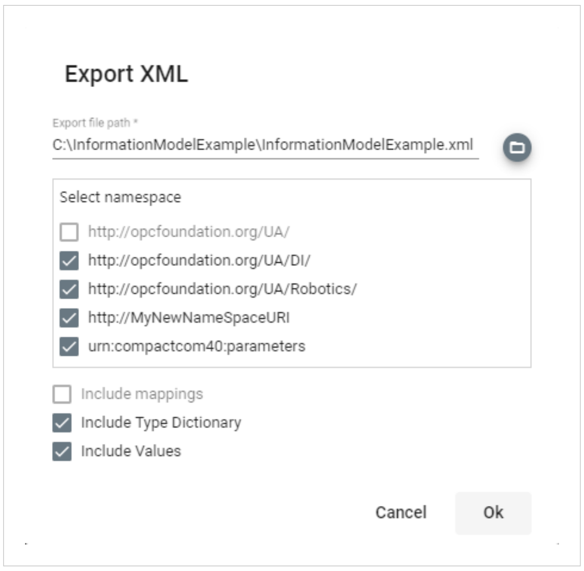
NodeID for the value of ADI number 101, 0x01006500 = 16803072.
The corresponding ADI-list for the Anybus CompactCom Host Application Example Code will look like this. The built-in data types on the OPC UA side is translated to Anybus CompactCom data types according to the translation table that can be found in the network guide for the Anybus CompactCom 40 IIoT Secure.

```
const AD_AdiEntryType APPL_asAdiEntryList[] =
{
   { 100,
"MotorTemperature", ABP_DOUBLE, 1, APPL_NOT_MAP_WRITE_ACCESS_DESC, {
{ &appl_MotorTemperature, NULL } } },

   { 101, “SerialNumber”,     ABP_CHAR,
8, APPL_NOT_MAP_WRITE_ACCESS_DESC, { { appl_SerialNumber,
NULL } } }
};
```

8. Export XML.

   Click the ‘Export XML‘ button and fill out the information. Select all included namespaces and check the ‘Include Type Dictionary’ and ‘Include Values’ checkboxes. Click ‘Ok’.



Export XML

Export file path *
C:\InformationModelExample\InformationModelExample.xml

Select namespace

- [ ] http://opcfoundation.org/UA/
- [x] http://opcfoundation.org/UA/DI/
- [x] http://opcfoundation.org/UA/Robotics/
- [x] http://MyNewNameSpaceURI
- [x] urn:compactcom40:parameters

- [ ] Include mappings
- [x] Include Type Dictionary
- [x] Include Values

9. The exported information model is now ready to be encoded by the Anybus OPC UA NodeSet Encoder.

3. Related Documents and Tools

To help with the certificate handling when connecting to the new information model, there is an application note and a certificate generator available on the support pages.

- Application Note – How to connect the Anybus CompactCom 40 IIoT Secure to UaExpert (Unified Automation)
- Certificate Generator