## OPC Group and Item Subscription

OPCDA control device objects and interfaces are called OPC Servers. Applications, called OPC Clients, can connect to OPC Servers provided by one or more vendors. Once the OPC Server connection has been established, an OPC group is created and tags are added for data monitoring.



Figure 1 OPC System Architecture

Figure 1 shows the functionality of the OPC DA specification within a CNC Architecture, which includes the following concepts:

* **OPC Server** is a COM object to which the OPC client first connects. The OPC Server handles connectivity to automation hardware. Its responsibility is to manage OPC groups, translate errors, provide server status, and allow browsing of OPC items.
* **OPC Group** is a COM object for logically organizing data items. OPC clients can pick and choose among the known OPC items on the OPC server in order to create groups. OPC Groups are managed by the OPC client who can activate or deactivate the group, change the group name or update rate among and subscribe for data change event notification. Reading and writing of OPC data is done through the OPC Group.
* **OPC Item** is a single tag (or automation device data point) managed by the OPC server. OPC does not define any application item tag names, e.g., AxisLocation. Instead, OPC clients rely on the vendor to allow clients to browse for OPC data items, or provide a list of OPC data items.

🟏🟏🟏 Note, the SHDR OPC client only uses one OPC Group with a set of items.🟏🟏🟏

Figure 1 OPC System ArchitectureFigure 1 shows OPC data management for a simple CNC OPC Server example. The OPC Client creates 2 OPC Groups, Group 1 containing the MachineMode, CycleOn, Ready and Program OPC Items, while Group 2 contains the BlockLine and BlockNumber OPC Items. Group 1 and 2 could run at different update rates if the data timeliness is an issue. To improve performance, if the CNC is in Manual mode, the Group 2 items BlockLine and BlockNumber could be deactivated. Note, only one OPC group and a set of tags are possible with the current setup.

Under an OPC Server section in the INI file, is a mapping of MT Connect tags into an equivalent OPC Server tag. Because MT Connect has two forms of tags – Sample and Event, the general form of the tag definition is

Tag.{Enum|Const}.[Sample|Event|Condition]=OPCTag

{X|Y} means optionally X or Y and where [X |Y] means one of X or Y. For example, Tag.Sample.Srpm specifies that the Spindle tag is a Sample, whose MT Connect name is “Srpm” and whose OPC tag is /Channel/Spindle/actSpeed[1] as defined below.

Tag.Sample.Srpm=/Channel/Spindle/actSpeed[1]

There is no enum involved in the Srpm. In the case of machine mode, the tag uses an Enum to specify this and Enum tags are associated with various mode values.

Tag.Enum.Event.controllermode=/Bag/State/opMode

Shown below enumeration strings are assigned to tag mode in the INI file using the mode MT Connect terminology mapping OPC server values (0,1,2).

Enum.controllermode.0 = MANUAL

Enum.controllermode.1 = MANUAL\_DATA\_ENTRY

Enum.controllermode.2 = AUTOMATIC

## Modifications to Ini File to Support Measurment

Additions to MTConnect Probe.xml device configuration file :

<DataItem type="PART\_COUNT" category="EVENT" name="probed"/>

<DataItem type="PATH\_POSITION" category="SAMPLE" subType="PROBE" name="MeasPoint1" />

<DataItem type="PATH\_POSITION" category="SAMPLE" subType="PROBE" name="MeasPoint2" />

<DataItem type="PATH\_POSITION" category="SAMPLE" subType="PROBE" name="MeasPoint3" />

<DataItem type="PATH\_POSITION" category="SAMPLE" subType="PROBE" name="MeasPoint4" />

<DataItem type="PATH\_POSITION" category="SAMPLE" subType="PROBE" name="SetPoint" />

<DataItem type="PATH\_POSITION" category="SAMPLE" subType="PROBE" name="ActualPoint" />

<DataItem type="DISPLACEMENT" category="SAMPLE" name="Tolerance" />

<DataItem type="DISPLACEMENT" category="SAMPLE" name="PlusTolerance" />

<DataItem type="DISPLACEMENT" category="SAMPLE" name="MinusTolerance" />

<DataItem type="DISPLACEMENT" category="SAMPLE" name="MinDeviation" />

<DataItem type="DISPLACEMENT" category="SAMPLE" name="MaxDeviation" />

<DataItem type="DISPLACEMENT" category="SAMPLE" name="Deviation" />

<DataItem type="DISPLACEMENT" category="EVENT" name="Outtol"/>

<DataItem type="TOOL\_ID" category="EVENT" name="ProbeNumber"/>

<DataItem type="PART\_ID" category="EVENT" name="CharacteristicType"/>

<DataItem type="PART\_ID" category="EVENT" name="FeatureType"/>

These data items must be there of MTConnect will not display the data if presented to it.

A summary of these tags is contained in the table below:

|  |  |  |
| --- | --- | --- |
| MTConnect Name | Subtype | Description |
| probed | PART\_COUNT | Event to signal a probing operation has completed |
| MeasPoint1 | PATH\_POSITION | Probed measurement 1 |
| MeasPoint2 | PATH\_POSITION | Probed measurement 2, if any |
| MeasPoint3 | PATH\_POSITION | Probed measurement 3, if any |
| MeasPoint4 | PATH\_POSITION | Probed measurement 4, if any |
| SetPoint | PATH\_POSITION | Setpoint to measure, if any |
| ActualPoint | PATH\_POSITION | Probing actual measurement |
| Tolerance | DISPLACEMENT | Tolerance (assume +/-) amount |
| PlusTolerance | DISPLACEMENT | Plus tolerance amount |
| MinusTolerance | DISPLACEMENT | Minus tolerance amount |
| MinDeviation | DISPLACEMENT | Minimum deviation during measurements |
| MaxDeviation | DISPLACEMENT | Maximum deviation during measurements |
| Deviation | DISPLACEMENT | Deviation of measurement (assume max) |
| Outtol | DISPLACEMENT | Out of tolerance amount, zero if within tolerance |
| ProbeNumber | TOOL\_ID | Probe number |
| CharacteristicType | PART\_ID | Characteristic measurement type: will be enumeration- point (x,y,z,etc), diameter, flatness, perpendicularity, etc. |
| FeatureType | PART\_ID | Associated feature to be probed |

Mappting to MTConnect Probe.xml device into Siemens 840D measuring OPC variables or block scanned items.

|  |  |  |
| --- | --- | --- |
| MTConnect Name | Subtype | 840D Mapping |
| probed | PART\_COUNT | /Channel/State/acMea[1] |
| MeasPoint1 | PATH\_POSITION | /Channel/State/aaMeasPoint1[1] [2] [3] |
| MeasPoint2 | PATH\_POSITION | /Channel/State/aaMeasPoint2[1] [2] [3] |
| MeasPoint3 | PATH\_POSITION | /Channel/State/aaMeasPoint3[1] [2] [3] |
| MeasPoint4 | PATH\_POSITION | /Channel/State/aaMeasPoint3[1] [2] [3] |
| SetPoint | PATH\_POSITION | MeasureSetPtx,MeasureSetPty,MeasureSetPtz |
| ActualPoint | PATH\_POSITION | Measure1x,Measure1y,Measure1z |
| Tolerance | DISPLACEMENT | \_TUL-\_TLL |
| PlusTolerance | DISPLACEMENT | Scan meas cycle block for \_TUL |
| MinusTolerance | DISPLACEMENT | Scan meas cycle block for \_TLL=- |
| MinDeviation | DISPLACEMENT | N/A |
| MaxDeviation | DISPLACEMENT | N/A |
| Deviation | DISPLACEMENT | Setpoint-actual |
| Outtol | PART\_COUNT | !=0 if(Setpoint-actual) > TUL or TLL |
| ProbeNumber | TOOL\_ID | /Channel/State/acMeasTNumber |
| CharacteristicType | PART\_ID |  |
| FeatureType | PART\_ID | /Channel/State/acMeasType |

Now the config.ini file that is read by the Siemens 840D OPC MTConnect Agent is modified to add these tags:

Tag.OPC.MeasureSetPtx=/Channel/MachineAxis/actToolBasePos[1]

Tag.OPC.MeasureSetPty=/Channel/MachineAxis/actToolBasePos[2]

Tag.OPC.MeasureSetPtz=/Channel/MachineAxis/actToolBasePos[3]

Tag.OPC.Measure1x=/Channel/State/aaMeasPoint1[1]

Tag.OPC.Measure1y=/Channel/State/aaMeasPoint1[2]

Tag.OPC.Measure1z=/Channel/State/aaMeasPoint1[3]

Tag.Enum.Event.CharacteristicType=/Channel/State/acMeasType

Tag.Enum.Event.CharacteristicType.0= Default

Tag.Enum.Event.CharacteristicType.1= x edge

Tag.Enum.Event.CharacteristicType.2= y edge

Tag.Enum.Event.CharacteristicType.3= z edge

Tag.Enum.Event.CharacteristicType.4= Corner 1

Tag.Enum.Event.CharacteristicType.5= Corner 2,

Tag.Enum.Event.CharacteristicType.6= Corner 3

Tag.Enum.Event.CharacteristicType.7= Corner 4

Tag.Enum.Event.CharacteristicType.8= Hole

Tag.Enum.Event.CharacteristicType.9= Shaft

Tag.Enum.Event.CharacteristicType.10= Tool length

Tag.Enum.Event.CharacteristicType.11= Tool diameter

Tag.Enum.Event.CharacteristicType.12= Groove

Tag.Enum.Event.CharacteristicType.13= Web

Tag.Enum.Event.CharacteristicType.14= Actual value setting for geo and special axes

Tag.Enum.Event.CharacteristicType.15= Actual value setting for special axes only

Tag.Enum.Event.CharacteristicType.16= Edge\_2P

Tag.Enum.Event.CharacteristicType.17= Plane\_Angles

Tag.Enum.Event.CharacteristicType.18= Plane\_Normal

Tag.Enum.Event.CharacteristicType.19= Dimension\_1

Tag.Enum.Event.CharacteristicType.20= Dimension\_2

Tag.Enum.Event.CharacteristicType.21= Dimension\_3

|  |  |  |
| --- | --- | --- |
| MTConnect Name | Subtype | POCDMIS Mapping |
| probed | PART\_COUNT |  |
| MeasPoint1 | PATH\_POSITION |  |
| MeasPoint2 | PATH\_POSITION |  |
| MeasPoint3 | PATH\_POSITION |  |
| MeasPoint4 | PATH\_POSITION |  |
| SetPoint | PATH\_POSITION | Command.DimensionCommand.Nominal |
| ActualPoint | PATH\_POSITION | Command.DimensionCommand.Measured |
| Tolerance | DISPLACEMENT |  |
| PlusTolerance | DISPLACEMENT | Command.DimensionCommand.Plus |
| MinusTolerance | DISPLACEMENT | Command.DimensionCommand.Minus |
| MinDeviation | DISPLACEMENT |  |
| MaxDeviation | DISPLACEMENT |  |
| Deviation | DISPLACEMENT | Command.DimensionCommand.Deviation |
| Outtol | PART\_COUNT | Command.DimensionCommand.OutTol |
| ProbeNumber | TOOL\_ID | PartProgram.CurrentProbeName |
| CharacteristicType | PART\_ID | Command.Type |
| FeatureType | PART\_ID |  |

|  |
| --- |
| DIMENSION\_X\_LOCATION |
| DIMENSION\_R\_LOCATION |
| DIMENSION\_Y\_LOCATION |
| DIMENSION\_Z\_LOCATION |
| DIMENSION\_D\_LOCATION |
| DIMENSION\_T\_LOCATION |
| DIMENSION\_L\_LOCATION |
| DIMENSION\_TRUE\_DIAM\_LOCATION |
| DIMENSION\_TRUE\_D1\_LOCATION |
| DIMENSION\_TRUE\_D2\_LOCATION |
| DIMENSION\_TRUE\_D3\_LOCATION |
| DIMENSION\_TRUE\_DD\_LOCATION |
| DIMENSION\_TRUE\_DF\_LOCATION |
| DIMENSION\_TRUE\_END\_POSITION |
| DIMENSION\_TRUE\_LD\_LOCATION |
| DIMENSION\_TRUE\_LF\_LOCATION |
| DIMENSION\_TRUE\_PA\_LOCATION |
| DIMENSION\_TRUE\_PR\_LOCATION |
| DIMENSION\_TRUE\_WD\_LOCATION |
| DIMENSION\_TRUE\_WF\_LOCATION |
| DIMENSION\_TRUE\_X\_LOCATION |
| DIMENSION\_TRUE\_Y\_LOCATION |
| DIMENSION\_TRUE\_Z\_LOCATION |
| DIMENSION\_V\_LOCATION |
| DIMENSION\_FLATNESS |
| DIMENSION\_KEYIN: |
| DIMENSION\_PA\_LOCATION |
| DIMENSION\_PR\_LOCATION |
| DIMENSION\_2D\_DISTANCE |
| DIMENSION\_3D\_ANGLE: |
| DIMENSION\_3D\_DISTANCE |
| DIMENSION\_A\_LOCATION |
| DIMENSION\_ANGULARITY: |
| DIMENSION\_COAXIALITY |
| DIMENSION\_CONCENTRICITY |
| DIMENSION\_PARALLELISM |
| DIMENSION\_PERPENDICULARITY |
| DIMENSION\_PROFILE |
| DIMENSION\_ROUNDNESS |
| DIMENSION\_RUNOUT |
| DIMENSION\_STRAIGHTNESS |