



**MTConnect® Standard**  
**Guide: MTConnect and OPC/UA**  
**Companion Specification**  
**Version 2.0**

Prepared for: MTConnect Institute  
Prepared by: William Sobel  
Prepared on: September 29, 2018

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# 1 Introduction

128 The following conventions will be used throughout the document to provide a  
129 clear and consistent understanding of the use of each type of data and information  
130 used to define the MTConnect<sup>®</sup> standard and associated data.

## 1.1 Overview

131 Overview of the standards...

# 2 Types

## 2.1 Components



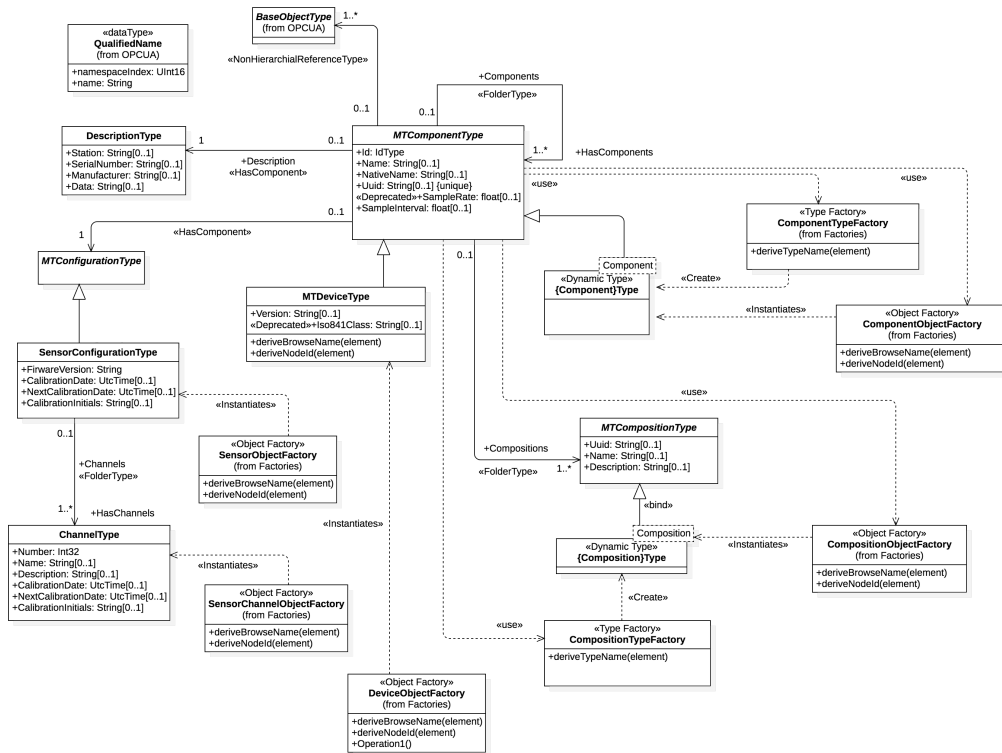


Figure 1: Components Diagram

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132 The Components documents the Component models and the owned objects.

### **2.1.1 Defintion of ChannelType**

**Table 1:** ChannelType Definition

Attribute	Value				
BrowseName	ChannelType				
IsAbstract	False				
References	NodeClass	BrowseName	Data Type	TypeDefinition	Modeling Rule
Subtype of BaseObjectType (See OPCUA Documentation)					
HasProperty	Variable	Number	Int32	PropertyType	Mandatory
HasProperty	Variable	Name	String	PropertyType	Optional
HasProperty	Variable	MTDescription	String	PropertyType	Optional
HasProperty	Variable	CalibrationDate	UtcTime	PropertyType	Optional
HasProperty	Variable	NextCalibrationDate	UtcTime	PropertyType	Optional
HasProperty	Variable	CalibrationInitials	String	PropertyType	Optional

### 2.1.2 Defintion of DescriptionType

133 The desription provides some general information about the manufacture and se-  
 134 rial number of the component. In the XML, the CDATA is freeform text that is  
 135 represented in the Data Property of the Description Object. The description is  
 136 related to the component with the OPC/UA HasComponent relationship.

**Table 2:** DescriptionType Definition

Attribute	Value				
BrowseName	DescriptionType				
IsAbstract	False				
References	NodeClass	BrowseName	DataType	TypeDefinition	Modeling Rule
Subtype of BaseObjectType (See OPCUA Documentation)					
HasProperty	Variable	Station	String	PropertyType	Optional
HasProperty	Variable	SerialNumber	String	PropertyType	Optional
HasProperty	Variable	Manufacturer	String	PropertyType	Optional
HasProperty	Variable	Data	String	PropertyType	Optional

### 137 2.1.2.1 Operations

- 138     • `deriveBrowseName(element)`  
139         Specification: "Description"
- 140     • `deriveNodeId(element)`  
141         Specification: `concat(self.parent.NodeId, BrowseName)`

## 2.1.3 Defintion of MTComponentType

142 The base Component Type from which all MTConnect Components are derived.  
143 The component type factory is used to create the specific OPC/UA Types as sub-  
144 types of the MTConnect MTComponentType. The component types will be  
145 created once for all Component objects of that type based on the QName of the  
146 MTConnect XML element.

147 The object factory will instantiate the Component Objects and insert them into  
148 the Components folder with a browse name of the Component QName and the  
149 name element if specified surrounded by square brackets, [ ]. For example if the  
150 MTConnect Element is:

151 `<Linear name='X'>...</...>`

**Table 3:** MTComponentType Definition

Attribute	Value				
BrowseName	MTComponentType				
IsAbstract	True				
References	NodeClass	BrowseName	DataType	TypeDefinition	Modeling Rule
HasProperty	Variable	XmlId	IdType	PropertyType	Mandatory
HasProperty	Variable	Name	String	PropertyType	Optional
HasProperty	Variable	NativeName	String	PropertyType	Optional
HasProperty	Variable	Uuid	String	PropertyType	Optional
HasProperty	Variable	SampleRate	float	PropertyType	Optional
HasProperty	Variable	SampleInterval	float	PropertyType	Optional
HasComponent	Object	Description		DescriptionType	Optional
HasComponent	Object	Configuration		MTConfigurationType	Optional
Organizes	Object	Components	MTComponentType	FolderType	Optional
Organizes	Object	Compositions	MTCompositionType	FolderType	Optional
HasProperty	Variable	<Dynamic>	DataItemType	<Dynamic>	Optional
HasProperty	Variable	<Dynamic>	BaseObjectType	<Dynamic>	Optional
Organizes	Object	Conditions	MTNonExclusiveConditionType	FolderType	Optional
HasProperty	Variable	<Dynamic>	DataItemType	<Dynamic>	Mandatory

152 The OPC/UA Object with browse name `Linear[X]` will be created with the  
 153 `HasTypeDefinition` referencing the `Linear` OPC/UA type.

154 The meta data for the component and it's relationships are static. The dynamic  
 155 data will be represented using the *OPC/UA Part 8*.

## 2.1.4 Defintion of MTCompositionType

**Table 4:** MTCompositionType Definition

Attribute	Value				
BrowseName	MTCompositionType				
IsAbstract	True				
References	NodeClass	BrowseName	DataType	TypeDefinition	Modeling Rule
Subtype of BaseObjectType (See OPCUA Documentation)					
HasProperty	Variable	Uuid	String	PropertyType	Optional
HasProperty	Variable	Name	String	PropertyType	Optional
HasProperty	Variable	MTDescription	String	PropertyType	Optional
NonHierarchicalReferenceType	Object	ecomposition	DataItemType	NonHierarchicalReferenceType	Optional

## 2.1.5 Defintion of MTConfigurationType

**Table 5:** MTConfigurationType Definition

Attribute	Value				
BrowseName	MTConfigurationType				
IsAbstract	True				
References	NodeClass	BrowseName	DataType	TypeDefinition	Modeling Rule
Subtype of BaseObjectType (See OPCUA Documentation)					

## 2.1.6 Defintion of MTDeviceType

156 The MTDevice is a special type whose object will be the root of the device graph.  
 157 The Device uses the component type factory and the component object factories  
 158 to create each of the first level components.

159 The compositions, relationships, and data items are then recursively created as  
 160 one decendes the MTConnect informaiton model.

**Table 6:** MTDeviceType Definition

Attribute	Value				
BrowseName	MTDeviceType				
IsAbstract	False				
References	NodeClass	BrowseName	DataType	TypeDefinition	Modeling Rule
Subtype of MTComponentType (see section 2.1.3)					
HasProperty	Variable	Version	String	PropertyType	Optional
HasProperty	Variable	Iso841Class	String	PropertyType	Optional

#### 161 **2.1.6.1 Operations**

- 162     • `deriveBrowseName(element)`  
163         **Specification:** `self.name`
- 164     • `deriveNodeId(element)`  
165         **Specification:** `self.uuid`

### **2.1.7 Defintion of `SensorConfigurationType`**

- 166 The `SensorConfiguration` browse name will be created as an Object relationship  
167 with the parent component.



**Table 7:** SensorConfigurationType Definition

Attribute	Value				
BrowseName	SensorConfigurationType				
IsAbstract	False				
References	NodeClass	BrowseName	DataType	TypeDefinition	Modeling Rule
Subtype of MTConfigurationType (see section 2.1.5)					
HasProperty	Variable	FirmwareVersion	String	PropertyType	Mandatory
HasProperty	Variable	CalibrationDate	UtcTime	PropertyType	Optional
HasProperty	Variable	NextCalibrationDate	UtcTime	PropertyType	Optional
HasProperty	Variable	CalibrationInitials	String	PropertyType	Optional
Organizes	Object	Channels	ChannelType	FolderType	Optional

## 2.1.8 Defintion of {Component} Type

**Table 8:** {Component} Type Definition

Attribute	Value				
BrowseName	ComponentType				
IsAbstract	False				
References	NodeClass	BrowseName	DataType	TypeDefinition	Modeling Rule
Subtype of MTComponentType (see section 2.1.3)					

## 2.1.9 Defintion of {Composition}Type

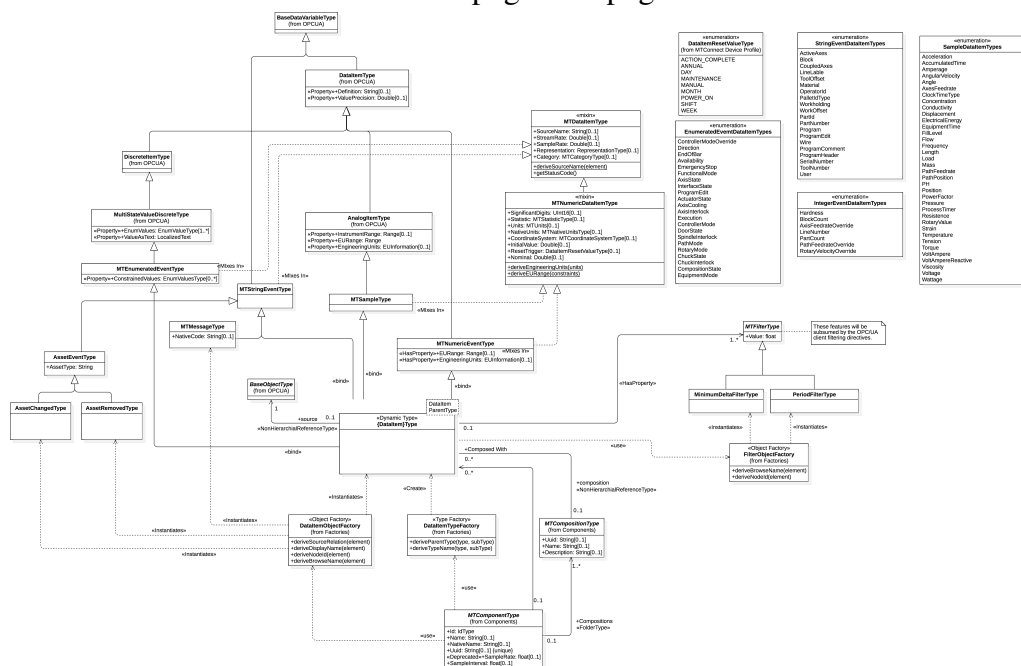
**Table 9:** {Composition}Type Definition

Attribute	Value				
BrowseName	CompositionType				
IsAbstract	False				
References	NodeClass	BrowseName	DataType	TypeDefinition	Modeling Rule
Subtype of MTCompositionType (see section 2.1.4)					

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## **2.2 Data Items**

Items.png Items.png



### Figure 2: Data Items Diagram

## 2.2.1 Defintion of AssetChangedType

**Table 10:** AssetChangedType Definition

Attribute	Value				
BrowseName	AssetChangedType				
IsAbstract	False				
References	NodeClass	BrowseName	DataType	TypeDefinition	Modeling Rule
Subtype of AssetEventType (see section 2.2.2)					

## 2.2.2 Defintion of AssetEventType

**Table 11:** AssetEventType Definition

Attribute	Value				
BrowseName	AssetEventType				
IsAbstract	False				
References	NodeClass	BrowseName	DataType	TypeDefinition	Modeling Rule
Subtype of MTStringEventType (see section 2.2.11)					
HasProperty	Variable	AssetType	String	PropertyType	Mandatory

### 2.2.3 Defintion of AssetRemovedType

**Table 12:** AssetRemovedType Definition

Attribute	Value				
BrowseName	AssetRemovedType				
IsAbstract	False				
References	NodeClass	BrowseName	DataType	TypeDefinition	Modeling Rule
Subtype of AssetEventType (see section 2.2.2)					

## 2.2.4 Defintion of `MTDataItemType`

168 The data item mixin will inject the properties and the methods into the related  
169 classes. This facility is similar to the Ruby module mixin or the Scala traits.



**Table 13:** MTDataItemType Definition

Attribute	Value				
BrowseName	MTDataItemType				
IsAbstract	False				
References	NodeClass	BrowseName	DataType	TypeDefinition	Modeling Rule
HasProperty	Variable	SourceName	String	PropertyType	Optional
HasProperty	Variable	StreamRate	Double	PropertyType	Optional
HasProperty	Variable	SampleRate	Double	PropertyType	Optional
HasProperty	Variable	Representation	RepresentationType	PropertyType	Optional
HasProperty	Variable	Category	MTCategoryType	PropertyType	Mandatory
HasProperty	Variable	<Dynamic>	MTFilterType	<Dynamic>	Optional
HasComponent	Object	source		BaseObjectType	Optional

#### 170 2.2.4.1 Operations

- 171     • `deriveSourceName(element)`  
172         Specification: `self.Source.CDATA`  
173         Documentation: Derive the source name from the Source element CDATA.  
174         This will represent the alternative long name for the data item's source.
- 175     • `getStatusCode()`  
176         Documentation: The OPC/UA status code will be created using the follow-  
177         ing process:
- 178         – If the value of the data item is UNAVAILABLE a status code of `Uncertain_-`  
179             `NoCommunicationLastUsable`
  - 180         – When a reset trigger is specified, new `Good_` status codes will be  
181             created. See `ResetTrigger` enumeration.

### 2.2.5 Defintion of MTEnumeratedEventType

182 All Data Items with Category EVENT having a Controlled Vocabularies will be  
183 of this type. Otherwise, `MTString`

**Table 14:** MTEnumeratedEventType Definition

Attribute	Value				
BrowseName	MTEnumeratedEventType				
IsAbstract	False				
References	NodeClass	BrowseName	DataType	TypeDefinition	Modeling Rule
Subtype of MultiStateValueDiscreteType (See OPCUA Documentation)					
HasProperty	Variable	ConstrainedValues	EnumValuesType	PropertyType	Mandatory

## 2.2.6 Defintion of MTFilterType

184 These features will be subsumed by the OPC/UA client filtering directives.

**Table 15:** MTFilterType Definition

Attribute	Value				
BrowseName	MTFilterType				
IsAbstract	True				
References	NodeClass	BrowseName	DataType	TypeDefinition	Modeling Rule
HasProperty	Variable	Value	float	PropertyType	Mandatory

### 185 2.2.6.1 Operations

- 186     • `deriveBrowseName(element)`  
 187         **Specification:** `concat(parent.BrowseName, pascalCase(element.type))`
- 188     • `deriveNodeId(element)`  
 189         **Specification:** `concat(parent.NodeId, pascalCase(element.type))`

## 2.2.7 Defintion of `MTMessageType`

**Table 16:** `MTMessageType` Definition

Attribute	Value				
BrowseName	MTMessageType				
IsAbstract	False				
References	NodeClass	BrowseName	DataType	TypeDefinition	Modeling Rule
Subtype of <code>MTStringEventType</code> (see section 2.2.11)					
HasProperty	Variable	NativeCode	String	PropertyType	Optional

### **2.2.8 Defintion of MTNumericDataItemType**

190 These are the additional attributes that are relevent to numeric data items. The  
191 factory will evaluate these values and will set the engineering units and the range  
192 associated with the parent entity.

**Table 17:** MTNumericDataItemType Definition

Attribute	Value				
BrowseName	MTNumericDataItemType				
IsAbstract	False				
References	NodeClass	BrowseName	Data Type	TypeDefinition	Modeling Rule
Subtype of MTDataItemType (see section 2.2.4)					
HasProperty	Variable	SignificantDigits	UInt16	PropertyType	Optional
HasProperty	Variable	Statistic	MTStatisticType	PropertyType	Optional
HasProperty	Variable	Units	MTUnits	PropertyType	Optional
HasProperty	Variable	NativeUnits	MTNativeUnitsType	PropertyType	Optional
HasProperty	Variable	CoordinateSystem	MTCoordinateSystemType	PropertyType	Optional
HasProperty	Variable	InitialValue	Double	PropertyType	Optional
HasProperty	Variable	ResetTrigger	DataItemResetValueType	PropertyType	Optional
HasProperty	Variable	Nominal	Double	PropertyType	Optional

### 2.2.8.1 Operations

- `deriveEngineeringUnits(units)`  
**Specification:** `EngineeringUnits <- self.units`
- `deriveEURange(constraints)`  
**Specification:** `EURange.Low <- self.Constraints.Minimum EURange.High <- self.Constraints.Maximum`  
**Documentation:** Uses the MTConnect Constraints element if present to derive the minimum and maximum values for the numeric values. This applies to both the Numeric Event and the Sample types.

## 2.2.9 Defintion of MTNumericEventType

All data items with category EVENT and a numeric value.

**Table 18:** MTNumericEventType Definition

Attribute	Value				
BrowseName	MTNumericEventType				
IsAbstract	False				
References	NodeClass	BrowseName	DataType	TypeDefinition	Modeling Rule
Subtype of DataItemType (See OPCUA Documentation)					
HasProperty	Variable	EURange	Range	PropertyType	Optional
HasProperty	Variable	EngineeringUnits	EUInformation	PropertyType	Optional

### 2.2.10 Defintion of MTSampleType

203 Data Items with category SAMPLE

**Table 19:** MTSampleType Definition

Attribute	Value				
BrowseName	MTSampleType				
IsAbstract	False				
References	NodeClass	BrowseName	DataType	TypeDefinition	Modeling Rule
Subtype of AnalogItemType (See OPCUA Documentation)					

### 2.2.11 Definition of `MTStringEventType`

204 All data items with category EVENT where the data is freeform text. The set\_  
 205 data\_type constraint derives makes the data type a string for this type.

**Table 20:** `MTStringEventType` Definition

Attribute	Value				
BrowseName	MTStringEventType				
IsAbstract	False				
References	NodeClass	BrowseName	DataType	TypeDefinition	Modeling Rule
Subtype of <code>BaseDataVariableType</code> (See OPCUA Documentation)					

## 2.2.12 Defintion of MinimumDeltaFilterType

**Table 21:** MinimumDeltaFilterType Definition

Attribute	Value				
BrowseName	MinimumDeltaFilterType				
IsAbstract	False				
References	NodeClass	BrowseName	DataType	TypeDefinition	Modeling Rule
Subtype of MTFilterType (see section 2.2.6)					



### 2.2.13 Defintion of PeriodFilterType

**Table 22:** PeriodFilterType Definition

Attribute	Value				
BrowseName	PeriodFilterType				
IsAbstract	False				
References	NodeClass	BrowseName	DataType	TypeDefinition	Modeling Rule
Subtype of MTFilterType (see section 2.2.6)					

## 2.2.14 Definition of {DataItem} Type

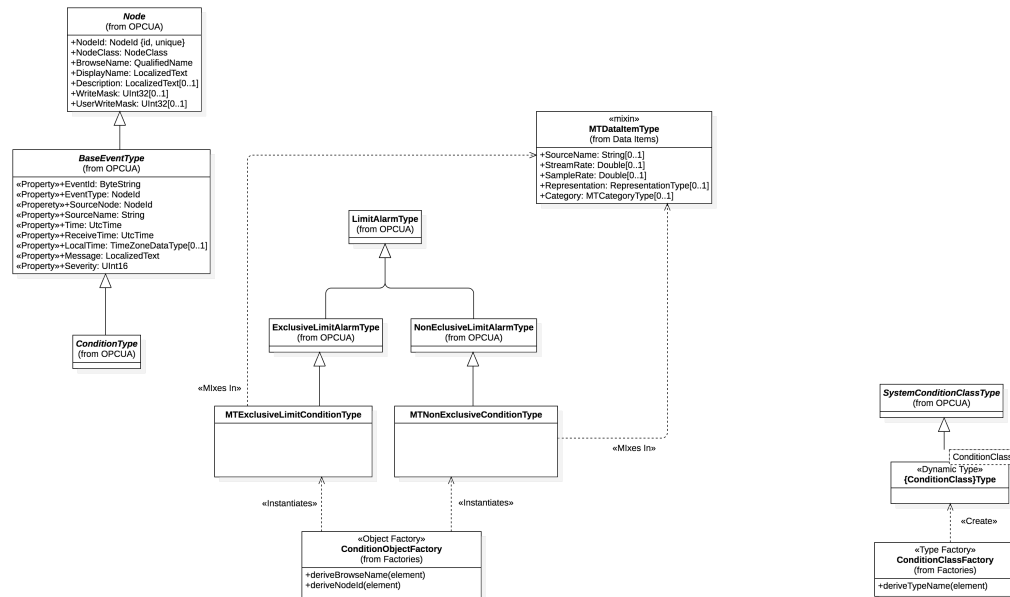
206 For each DataItem the Sub Type, and the Type will be composed to be the HasTypeDefinition  
 207 relationship of the object. The BrowseName will also include the Composition  
 208 Type if a composition Id is provided.

**Table 23:** {DataItem} Type Definition

Attribute	Value				
BrowseName	DataItemType				
IsAbstract	False				
References	NodeClass	BrowseName	DataType	TypeDefinition	Modeling Rule
Subtype of MTNumericEventType (see section 2.2.9)					

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## **2.3 Conditions**



### Figure 3: Conditions Diagram

### 2.3.1 Defintion of MTEExclusiveLimitConditionType

**Table 24:** MTEExclusiveLimitConditionType Definition

Attribute	Value				
BrowseName	MTExclusiveLimitConditionType				
IsAbstract	False				
References	NodeClass	BrowseName	DataType	TypeDefinition	Modeling Rule
Subtype of ExclusiveLimitAlarmType (See OPCUA Documentation)					

### 2.3.2 Defintion of MTNonExclusiveConditionType

**Table 25:** MTNonExclusiveConditionType Definition

Attribute	Value				
BrowseName	MTNonExclusiveConditionType				
IsAbstract	False				
References	NodeClass	BrowseName	DataType	TypeDefinition	Modeling Rule
Subtype of NonEclusiveLimitAlarmType (See OPCUA Documentation)					

### 2.3.3 Defintion of {ConditionClass}Type

**Table 26:** {ConditionClass}Type Definition

Attribute	Value				
BrowseName	ConditionClassType				
IsAbstract	False				
References	NodeClass	BrowseName	DataType	TypeDefinition	Modeling Rule
Subtype of SystemConditionClassType (See OPCUA Documentation)					

## 2.4 Factories

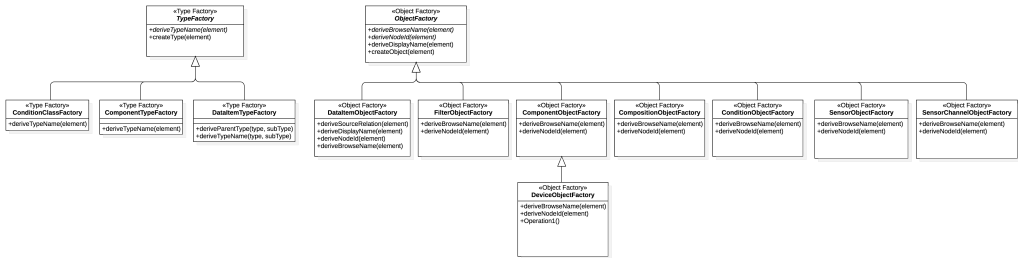


Figure 4: Factories Diagram

209 The factories are not part of the OPC/UA information model. They are a set  
 210 of helper classes that are used to create dynamic types and objects. Since the  
 211 MTConnect information model can be layered on top of the OPC/UA abstractions,  
 212 the factories provide the rules for creating the browse and display names for each  
 213 type.

214 The factories also create dynamic objects when required for variables of various  
 215 classes when they are required, such as the Data Items and the Components. Some  
 216 of the relationships are more complex since they require a dynamic super-type  
 217 relationship that relies on the correct placement of the MTConnect elements to be  
 218 correctly represented using the OPC/UA base types.

219 This is especially evident when mapping the DataItems and the Conditions to the  
 220 MTConnect Information Models and providing sufficient definition to allow for  
 221 unambiguous implementation.

## 2.4.1 Defintion of «Object Factory» **ComponentObjectFactory**

### 222 2.4.1.1 Operations

223 • `deriveBrowseName(element)`  
 224     Specification: `concat(element.QName, (if self.name.notEmpty()`  
 225     `then concat('[' , self.name, ']')) else " endif))`  
 226 • `deriveNodeId(element)`  
 227     Specification: `concat(self.findDevice().uuid, element.id)`

## 2.4.2 Defintion of «Type Factory» **ComponentTypeFactory**

228 The 'ComponentTypeFactory' creates component types using the MTConnect  
 229 XML element as an input. The factory takes the 'QName' (or qualified name)  
 230 of the XML element and then appends 'Type'. For example an '<Controller  
 231 id='...'></...>' element will create an OPC/UA 'ControllerType' type definition  
 232 as an extension of the base 'MTControllerType'.



233 Currently there is no additional abstractions or super types required by the com-  
 234 panion specification. The types will be a single level where each Component is a  
 235 sub-type of the base 'MTComponentType'.

#### 236 2.4.2.1 Operations

237 • deriveTypeName(element)  
 238 Specification: derive: Component <- element.QName  
 239 Documentation: The QName of the element for the component will be used  
 240 to derive the type of the node.

### 2.4.3 Defintion of «Object Factory» CompositionObjectFactory

#### 241 2.4.3.1 Operations

242 • deriveBrowseName(element)  
 243 Specification: concat(pascalCase(element.type), (if self.name.notEmpty()  
 244 then concat('[', self.name, ']') else " endif))  
 245 • deriveNodeId(element)  
 246 Specification: concat(self.findDevice().uuid, element.id)

### 2.4.4 Defintion of «Type Factory» CompositionTypeFactory

#### 247 2.4.4.1 Operations

248 • deriveTypeName(element)  
 249 Specification: derive: Composition <- pascalCase(element.type)  
 250 Documentation: The type for the composition will be created using the pas-  
 251 cal case of the 'type' from the composition element.

## 2.4.5 Defintion of «Type Factory» `ConditionClassFactory`

### 252 2.4.5.1 Operations

- 253 • `deriveTypeName(element)`  
254 Documentation: Create condition classes based on the OPC/UA three con-  
255 dition types.

## 2.4.6 Defintion of «Object Factory» `ConditionObjectFactory`

### 256 2.4.6.1 Operations

- 257 • `deriveBrowseName(element)`
- 258 • `deriveNodeId(element)`

## 2.4.7 Defintion of «Object Factory» `DataItemObjectFactory`

### 259 2.4.7.1 Operations

- 260 • `deriveSourceRelation(element)`  
261 Documentation: Use the source composition, component id, or data item id  
262 to locate the source node id for this relationship. If one exists, add an object  
263 with browse name "source" that relates to the entity referenced by the id.  
264 The most specific identity should be used in the following order:
  - 265 – `DataItemId`
  - 266 – `CompositionId`
  - 267 – `ComponentId`
- 268 Since the data item implies composition and component and the compo-  
269 sition implies component, there should only be one attribute given for the  
270 source.

271     • `deriveDisplayName(element)`  
272         Documentation: Same as the `BrowseName`.

273     • `deriveNodeId(element)`  
274         Documentation: The `nodeId` will be given by the device `uuid` and the `DataItem`  
275         `id` attribute.

276     • `deriveBrowseName(element)`  
277         Documentation: The browse name will be composed of the following parts  
278         of the model:

279         1. If the `compositionId` is present, the `compositionId` will be resolved the  
280             the `Composition` element and the pascal case of the type attribute will  
281             be placed first.

282         2. If the `subType` is present, the pascal case of the `subType` will be placed  
283             next.

284         3. The pascal case of the type will be placed last.

285     For example, for a data item with the following attributes:

286         – type: `TEMPERATURE`  
287         – composition type: `STORAGE_BATTERY`

288     will have the following browse name: `StorageBatteryTemperature`

289     For the data item with the following attributes:

290         – type: `ANGLE`  
291         – subType: `ACTUAL`  
292         – composition type: `ENCODER`

293     will have the following browse name: `EncoderActualAngle`

## 2.4.8 Defintion of «Type Factory» `DataItemTypeFactory`

294     Based on the data item category, type, and `subType`, this class creates a new  
295     OPC/UA type and also provides the template parameter for the `ParentType` from  
296     which this type is derived.

### 297 2.4.8.1 Operations

- 298 • `deriveParentType(type, subType)`  
 299 Documentation: The parent type is derived from the category as follows:
  - 300 – `SAMPLE -> SampleType`
  - 301 – `EVENT ->`
    - 302 \* `Enumerated Value -> MTEnumeratedEventType`
    - 303 \* `Integer Value -> MTNumericEventType`
    - 304 \* `Otherwise -> MTStringEventType`
- 305 • `deriveTypeName(type, subType)`  
 306 Specification: `concat(pascalCase(subType), pascalCase(type))`  
 307 Documentation: Used to derive the class name for creating a pascal case  
 308 name from the sub type and the type. For example type `ROTARY_VELOCITY`  
 309 and subType `ACTUAL` will become `ActualRotaryVelocity`.

## 2.4.9 Defintion of «Object Factory» DeviceObjectFactory

310 The model instantiation for MTConnect begins with the ‘Device’ MTConnect  
 311 element and then recursively traverses the sub-elements. The device will the ca-  
 312 pabilities in the component factory to generate all the data items and component  
 313 types.

### 314 2.4.9.1 Operations

- 315 • `deriveBrowseName(element)`  
 316 Specification: `derive: element.name`
- 317 • `deriveNodeId(element)`  
 318 Specification: `derive: element.uuid`

## 2.4.10 Defintion of «Object Factory» **FilterObjectFactory**

319 Creates filters based on the type attribute of the Filter element.

### 320 2.4.10.1 Operations

- 321 • `deriveBrowseName(element)`
- 322 • `deriveNodeId(element)`
- 323 Documentation: The node id is composed of the data item id and the browse
- 324 name.

## 2.4.11 Defintion of «Object Factory» **ObjectFactory**

### 325 2.4.11.1 Operations

- 326 • `deriveBrowseName(element)`
- 327 • `deriveNodeId(element)`
- 328 • `deriveDisplayName(element)`
- 329 Specification: `deriveBrowseName(element)`
- 330 • `createObject(element)`

## 2.4.12 Defintion of «Object Factory» **SensorChannelObjectFactory**

### 331 2.4.12.1 Operations

- 332 • `deriveBrowseName(element)`
- 333 Specification: `concat('Channel', self.number)`
- 334 • `deriveNodeId(element)`
- 335 Specification: `concat(self.parent.NodeId, BrowseName)`

### **2.4.13 Defintion of «Object Factory» SensorObjectFactory**

#### **336 2.4.13.1 Operations**

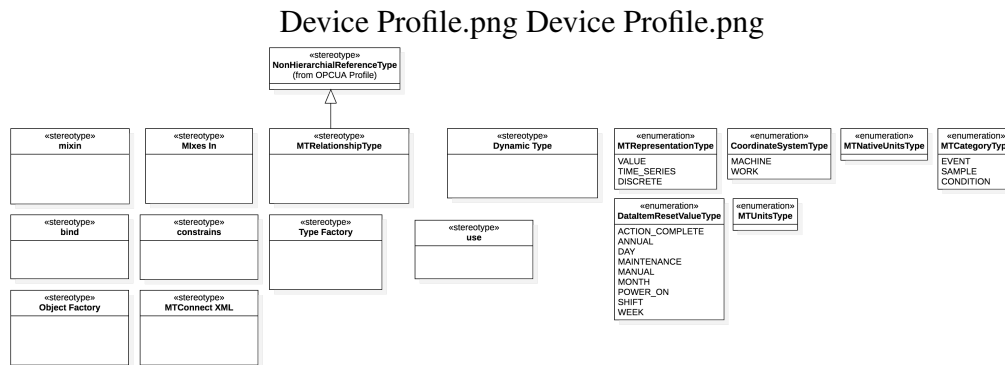
- 337     • `deriveBrowseName(element)`  
338         Specification: `element.QName`
- 339     • `deriveNodeId(element)`  
340         Specification: `concat(self.parent.NodeId, BrowseName)`

### **2.4.14 Defintion of «Type Factory» TypeFactory**

#### **341 2.4.14.1 Operations**

- 342     • `deriveTypeName(element)`
- 343     • `createType(element)`

## **2.5 MTConnect Device Profile**



**Figure 5: MTConnect Device Profile Diagram**

344 The device profile documents the common data types and stereotypes that are used  
 345 to construct the model. A stereotype is a design or modeling pattern that provides  
 346 additional information about the type or the relationship between types.

347 It can also identify the behavior of a property or the role the type or relation will  
 348 play in the model.

349 Stereotypes are used throughout the model to provide additional information that  
 350 will help provide context and definition to aid in better understanding the data  
 351 model.

## 2.5.1 Defintion of Dynamic Type

## 2.5.2 Defintion of MTConnect XML

## 2.5.3 Defintion of MTRelationshipType

## 2.5.4 Defintion of Mixes In

352 This stereotype is associated with the dependency between a type and a mixin.  
 353 See Section 2.5.9 for a complete description of the mixin.

## **2.5.5 Defintion of Object Factory**

## **2.5.6 Defintion of Type Factory**

## **2.5.7 Defintion of bind**

354 When a dynamic type (See Section 2.5.1) creates an instance where the super-type  
355 can be associated based on the data item category and type, the `Type Factory`  
356 will specify which supertype is to be referenced.

357 The `bind` stereotype indicates the relationship between the dynamic sub-type and  
358 the parent type are resolved baed on the `MTConnect DataItem` meta data.

## **2.5.8 Defintion of constrains**

## **2.5.9 Defintion of mixin**

359 The mixin pattern injects the properties and operations into the types that are  
360 related to the using the `Mixes In` dependency. Mixins allow for lightweight  
361 multiple inheritance. Since OPC/UA does not allow for multiple inheritance and  
362 the `MTConnect` types require the same set of properties when they are sub-typed  
363 from existing OPC/UA types, this mechanism allows for this relationship to be  
364 expressed.

## **2.5.10 Defintion of use**

365 The `use` stereotype indicates that one class uses as a helper to perform a specific  
366 operation or activity. This stereotype is mainly used to indicate that a specific  
367 factory is being employed by another type to create dynamic properties or rela-  
368 tionships.