

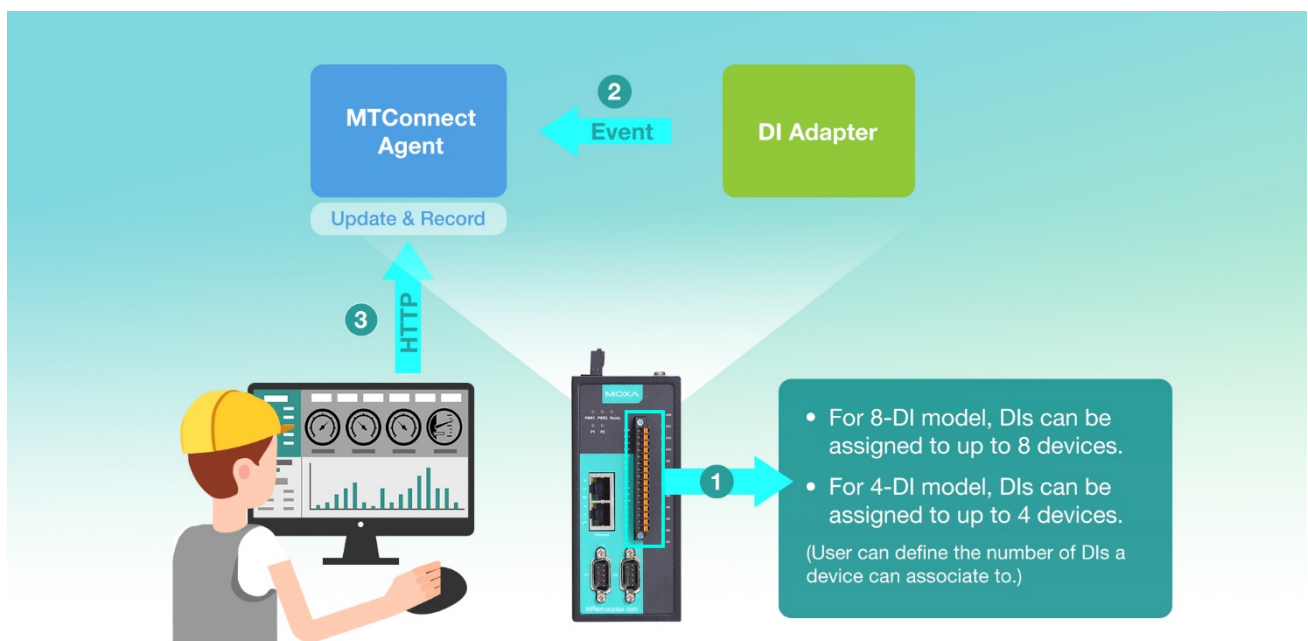
Bring Your Machine Data into MTConnect Applications

MTConnect in Brief

MTConnect is specifically designed for shop-floor applications that aim to define their shop-floor data in a standard format that can be understood by any MTConnect-compliant software applications. Once the data (for example, name, type, description, etc.) has been defined by MTConnect compliant interface, there is no need to redefine the data within each application.

For those legacy machine tools that do not support MTConnect natively, common practice is to get machine-related data through sensor connections and I/Os. Moxa's NPort IA(W)5000A-I/O supports MTConnect-enabled capabilities for all digital inputs on the device and provides a configurable interface for users to define what data items and desirable MTConnect tags they need to tie to the digital inputs.

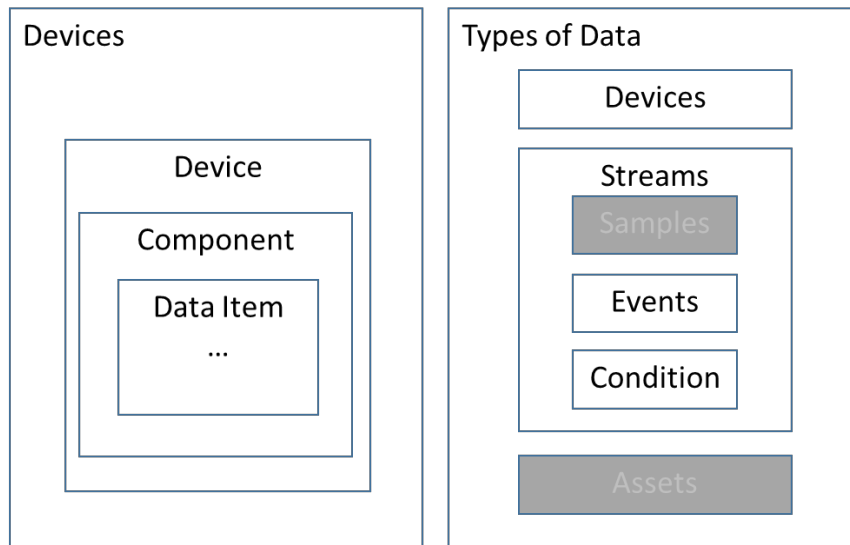
The NPort serves as an adapter as well as an agent to update and record MTConnect tags whenever an event is triggered. A client application is the requester and consumer of MTConnect data, which typical functions are to request, store, manipulate, and display data.



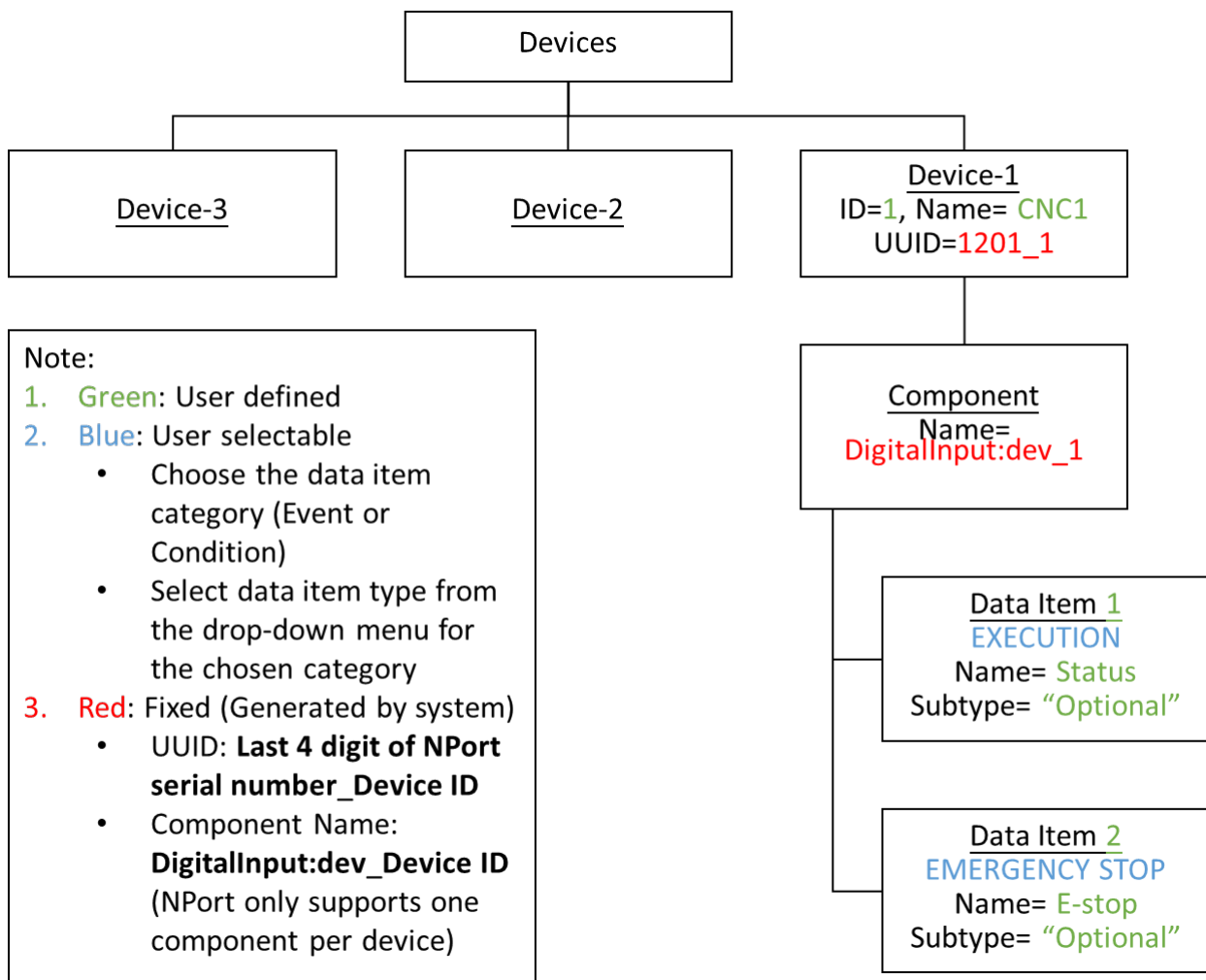
MTConnect Devices and Data Types

An MTConnect “Device” is a piece of equipment, such as a CNC machine or robot, organized as a set of components that provides data.

MTConnect defines the following types of data: devices, streams and assets. The NPort covers devices and streams but not assets. Within streams, the NPort covers all data items in Events and Condition but not Samples. (A Sample is a continuous series of data points and the NPort currently supports only DI of which the acquisition of continuous data is not applicable at this point.)



For example, a device named “CNC-1” is composed of a component: **DigitalInput:dev_1**. The component then has an Event or Condition data item definition. In this example, the **DigitalInput:dev_1** component has Event data items: “EXECUTION” and “EMERGENCY_STOP”.



Code-Free MTConnect Tag Configuration

The NPort IA(W)5000A-I/O provides a web interface that is easy to configure, enabling users to convert digital inputs into MTConnect data values. The following major steps are required to complete MTConnect settings on the NPort.

Determine the data items of your device (components)

Before configuring the NPort, one needs to understand where the data, which needs to be collected through digital inputs on the NPort, is coming from on the device. Below is an example where several elements on a CNC controller may be able to provide input signals that represent a machine state.



These elements have their MTConnect-defined data items and corresponding valid data values stated in the table below as follows:

Data Item Type	Category	Valid Data Values
Execution	Event	READY ACTIVE INTERRUPTED FEED HOLD STOPPED OPTIONAL_STOP PROGRAM_STOPPED PROGRAM_COMLETED
Emergency_Stop	Event	ARMED TRIGGERED
Controller_Mode	Event	AUTOMATIC MANUAL MANUAL_DATA_INPUT SEMI_AUTOMATIC EDIT
Functional_Mode	Event	PRODUCTION SETUP TEARDOWN MAINTENANCE PROCESS DEVELOPMENT

Users will need to configure these data items in the NPort so that the controller can be properly described with these elements.

⚙️ MTConnect Device-1 Settings

Device Settings

MTConnect Device ID

MTConnect Device Name

Data Item Settings

Data Item ID	Name	Type	Subtype	Category	Current Value
1	Status	EXECUTION		Event	READY
2	E-stop	EMERGENCY_STOP		Event	ARMED
3	Mode	CONTROLLER_MODE		Event	MANUAL

+ Add ✎ Edit 🗑 Delete

MTConnect Data Item Editing

Device-1 Data Item Attribute Settings

MTConnect Data Item ID → User defined

MTConnect Data Item Name → User defined

MTConnect Data Item Category → MTConnect Standard

MTConnect Data Item Type → MTConnect Standard

MTConnect Data Item Subtype

- ACTUATOR_STATE
- ACTIVE_AXES
- AVAILABILITY
- AXIS_COUPLING
- AXIS_FEEDRATE_OVERRIDE
- AXIS_INTERLOCK
- AXIS_STATE
- BLOCK
- CHUCK_INTERLOCK
- CHUCK_STATE
- CODE
- CONTROLLER_MODE
- COUPLED_AXES
- DIRECTION
- DOOR_STATE
- END_OF_BAR
- EMERGENCY_STOP
- EXECUTION
- FUNCTIONAL_MODE
- INTERFACE_STATE

Determine signal behavior

Once the data items is set within the device, map the data items with the digital inputs from which you get the data and choose the proper DI type (DI on/off or Pules on/off).

MTConnect Device-1 Settings

Device Settings

MTConnect Device ID

MTConnect Device Name

Data Item Settings

Data Item ID	Name	Type
1	Status1	EXECUTION
2	Program	PROGRAM
3	Mode1	CONTROLLER_MODE
4	Function_Mode	FUNCTIONAL_MODE
5	E-stop	EMERGENCY_STOP

MTConnect Event Settings

Enable MTConnect Detection (Disable DI function)

Enable Timestamp Using Local Time

Information		Condition 1			and Condition 2		Triggered Data Item		Triggered Value	
No	In Use	Input	Mode	Period(s)	Input	Mode	Device Name	Data Item ID	Active Value	Inactive Value
1	<input checked="" type="checkbox"/>	DI-00	On	0.1	N/A	N/A	CNC_No1	1	Active	Program_Stopped
2	<input checked="" type="checkbox"/>	DI-01	On	0.1	N/A	N/A	CNC_No1	2	Model_A	No Program
3	<input checked="" type="checkbox"/>	DI-02	On	0.1	N/A	N/A	CNC_No1	5	Triggered	Armed
4	<input checked="" type="checkbox"/>	DI-03	On	0.1	N/A	N/A	CNC_No1	3	Automatic	Manual_Data_Input
5	<input checked="" type="checkbox"/>	DI-04	On	0.1	N/A	N/A	CNC_No1	4	Production	Setup

Determine active/inactive value of events

Assign a valid active/inactive triggered value so that the NPort will update the agent when the DI changes. The triggered values are defined in MTConnect protocol for each data item as stated in the table in the previous section. These values will be captured by the client software and visualized in a format that helps users easily understand the current machine status for better decision-making.

Below is an example using a Trakhound dashboard, a free and simple MDC client software for MTConnect devices that give a simplified view of machine status. With uniform data, developers and integrators can focus on useful and productive manufacturing analysis, rather than translation.

The screenshot displays two panels from the Trakhound dashboard. The top panel, 'Controller Status', shows the device 'moxa NPortIA5250A-12IO 574' with device ID 'CNC_No1'. It indicates the machine is 'ARMED' (green bar) and 'PROGRAM_STOPPED' (grey bar). The bottom panel, 'Production Status Times', shows production progress at 86.7% (green bar), setup at 13.2% (blue bar), and other metrics like tear down and maintenance at 0.0%.

Type of Requests Supported on NPort-MTConnect Agent

Currently, the MTConnect Agent on the NPort supports three main types of requests:

Probe request: the response describes the devices whose data is being reported.

Current request: retrieves the values of the devices' data items the moment the request is received.

Sample request: retrieves a list of past and/or current values for one or more data items

MTConnect follows the rules of HTTP to fetch and transmit the requested MTConnect command. These are examples of responses received from different commands:

Probe command: <http://IP of NPort:5000/probe>—as an example <http://192.168.127.254:5000/probe> gives the result as below:

```

<MTConnectDevices xmlns:m="urn:mtconnect.org:MTConnectDevices:1.3"
xmlns="urn:mtconnect.org:MTConnectDevices:1.3" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="urn:mtconnect.org:MTConnectDevices:1.3 /schemas/MTConnectDevices_1.3.xsd">
  <Header creationTime="2018-09-28T11:03:34Z" sender="MOXA" instanceId="1538130798"
version="1.3.0.17" assetBufferSize="1024" assetCount="0" bufferSize="16384"/>
  <Devices>
    <Device id="1" name="CNC1" sampleInterval="10" uuid="1201_1">
      <Description manufacturer="moxa" model="NPortIA5150A-12IO" serialNumber="1201"/>
      <DataItems>
        <DataItem category="EVENT" id="avail_1" type="AVAILABILITY"/>
      </DataItems>
      <Components>
        <DigitalInput id="di_1201_1" name="di_1">
          <DataItems>
            <DataItem category="EVENT" id="1" name="Status" type="EXECUTION"/>
            <DataItem category="EVENT" id="2" name="E-stop" type="EMERGENCY_STOP"/>
          </DataItems>
        </DigitalInput>
      </Components>
    </Device>
  </Devices>

```

Current command: <http://IP of NPort:5000/current>—as an example <http://192.168.127.254:5000/current> gives the result as below:

Device: CNC1; UUID:1201_1						
Device:CNC1						
Events						
Timestamp	Type	Sub Type	Name	Id	Sequence	Value
2018-09-28T10:33:17.403803Z	Availability			avail_1	11	AVAILABLE
DigitalInput:di_1						
Events						
Timestamp	Type	Sub Type	Name	Id	Sequence	Value
2018-09-28T10:33:17.403803Z	Execution		Status	1	9	AVAILABLE
2018-09-28T10:33:17.403803Z	EmergencyStop		E-stop	2	10	AVAILABLE

Sample command: <http://IP of NPort:5000/sample>—as an example <http://192.168.127.254:5000/sample> gives the result as below:

Device: CNC1; UUID:1201_1

Device:CNC1

Events Historical value

Timestamp	Type	Sub Type	Name	Id	Sequence	Value
2018-09-28T10:33:17.403803Z	Availability			avail_1	1	UNAVAILABLE
2018-09-28T10:33:17.403803Z	Availability			avail_1	11	AVAILABLE

DigitalInput:di_1

Events

Timestamp	Type	Sub Type	Name	Id	Sequence	Value
2018-09-28T10:33:17.403803Z	Execution		Status	1	9	AVAILABLE
2018-09-28T10:33:17.403803Z	EmergencyStop		E-stop	2	10	AVAILABLE