MTConnect Institute

Getting Started with MTConnect: Architecture

Draft 1

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MTConnect Specifications or Materials

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Introduction

MTConnect is a universal factory floor communications protocol. It is designed specifically for the shop floor environment. While there are numerous communication solutions available for the shop floor, MTConnect offers one very distinct difference. MTConnect is the first standard to define a "dictionary" for manufacturing data. This means that data from multiple machines will have a common definition – name, units, values, and context. With MTConnect, the data is defined only once at the MTConnect compliant interface to the device or machine tool. Once the data is defined based on the MTConnect standard protocol, it can then easily be used by all MTConnect compliant software applications. This eliminates the need to redefine the data within each application.

This fundamental difference significantly reduces startup time, overall project costs, and long term maintenance of software system interfaces. MTConnect compliant devices process information locally and then provide that data in a consistent format to any application - ERP, MES, Production Management Systems, Maintenance Systems, browsers, spreadsheets, and countless other applications. This approach leads to a plug-and-play atmosphere that mimics the PC computer arena.

The MTConnect Standard documentation consists of four parts:

- Part 1 of the MTConnect Standard provides an overview of the MTConnect Architecture and Protocol; including communication, fault tolerance, connectivity, and error handling require-ments.
- Part 2 of the MTConnect standard focuses on the data model and description of the information that is available from the device. The descriptive data defines how a piece of equipment should be modeled, the structure of the component hierarchy, the names for each component (if restricted), and allowable data items for each of the components.
- Part 3 of the MTConnect standard focuses on the data returned from a current or sample request (for more information on these requests, see Part 1). This section covers the data representing the state of the machine.
- Part 4 of the MTConnect standard provides a semantic model for entities that are used in the manufacturing process, but are not considered to be a device nor a component. These entities are defined as MTConnect Assets. These assets may be removed from a device without detriment to the function of the device, and can be associated with other devices during their lifecycle. The data associated with these assets will be retrieved from multiple sources that are responsible for providing their knowledge of the asset. The first type of asset to be addressed is Tooling.

Objective

The objective of this document is to supplement the MTConnect standard's documentation and outline conceptual architectural designs for the implementation of the MTConnect standard. Instructions for implementing software applications that use data conforming to the MTConnect standard or recommendations for vendor specific hardware and software are outside the scope of this document.

Glossary

Adapter An optional software component that connects the Agent to the Device.

Agent	A process that implements the MTConnect HTTP protocol, XML generation, and MTConnect protocol.
Application	A process or set of processes that access the MTConnect Agent to perform some task.
Data Item	A data item provides the descriptive information regarding something that can be collected by the *Agent*.
Device	A piece of equipment capable of performing an operation. A device may be composed of a set of components that provide data to the application. The device is a separate entity with at least one component or data item providing information about the device.

Conceptual Architecture

The most basic structure of an MTConnect implementation is outlined in *Figure 1 – MTConnect Architecture* below. This consists of a device, an adapter, an MTConnect agent, and a client or application.

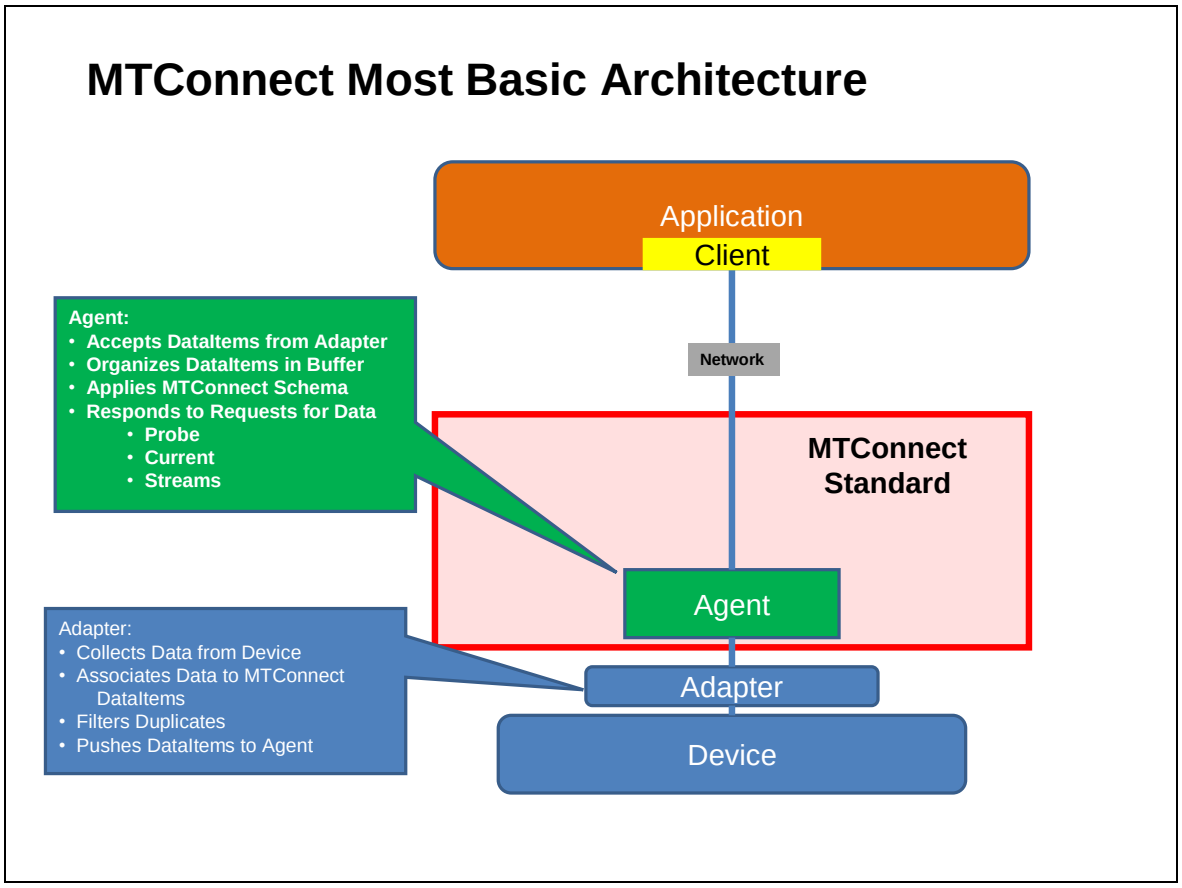

Figure 1 – MTConnect Basic Architecture

The above is the basic implementations of Parts 1, 2, and 3 of the MTConnect Standard. It does not include Mobile Assets, which is described in Part 4 of the Standard.

In configuring MTConnect, multiple devices can be connected to one agent as shown in *Figure 2*.

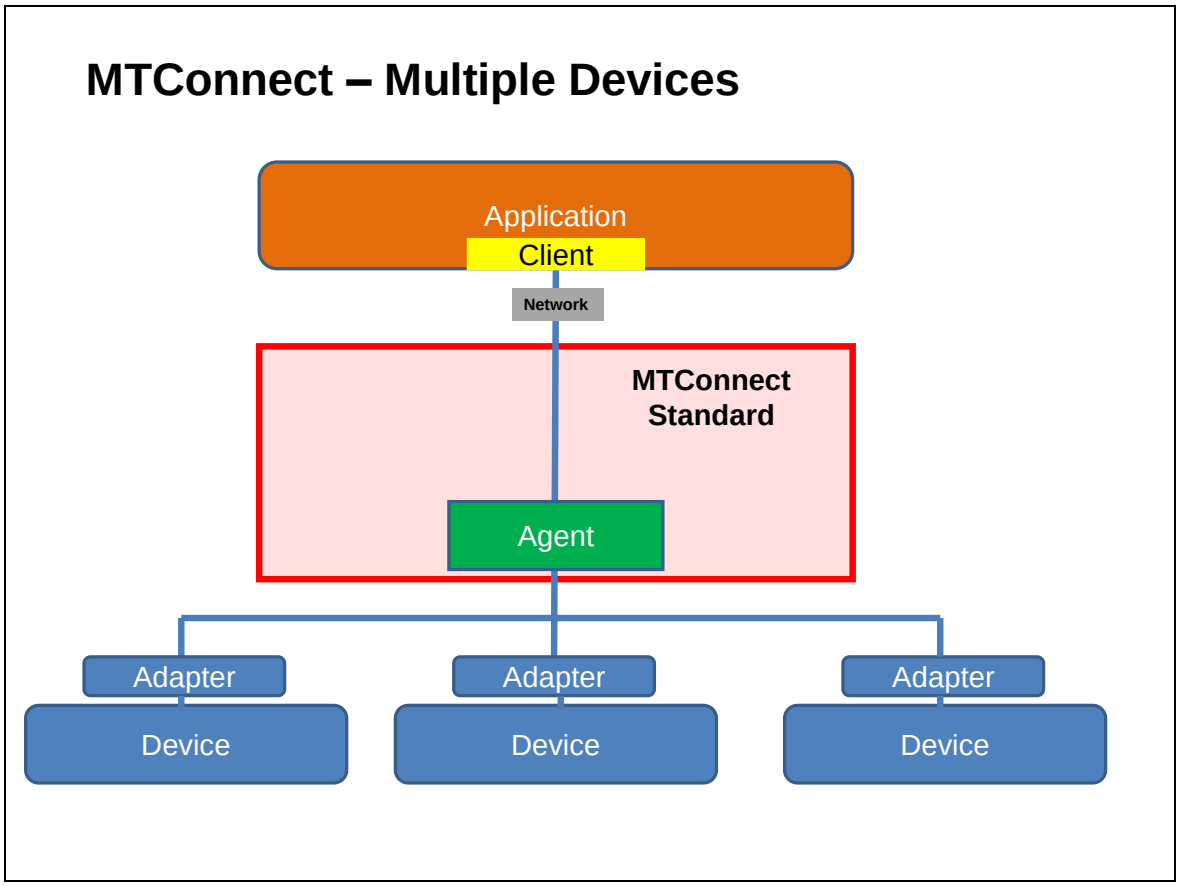

Figure 2 – Multiple Devices

Conversely, one device can be connected to multiple agents as shown and *Figure 3*.

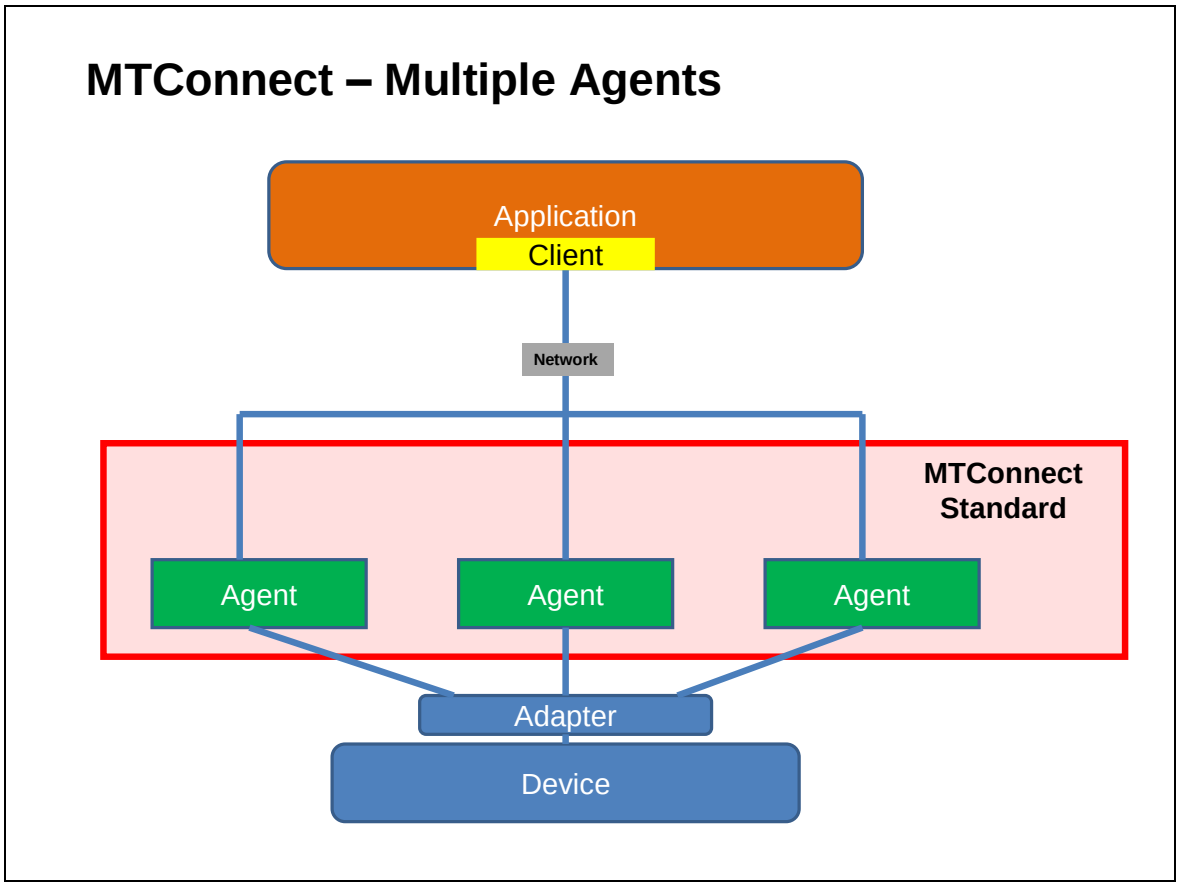

Figure 3 – Multiple Agents

There can also be a configuration that consists of multiple adapters for a given device with a single agent as illustrated in *Figure 4*.

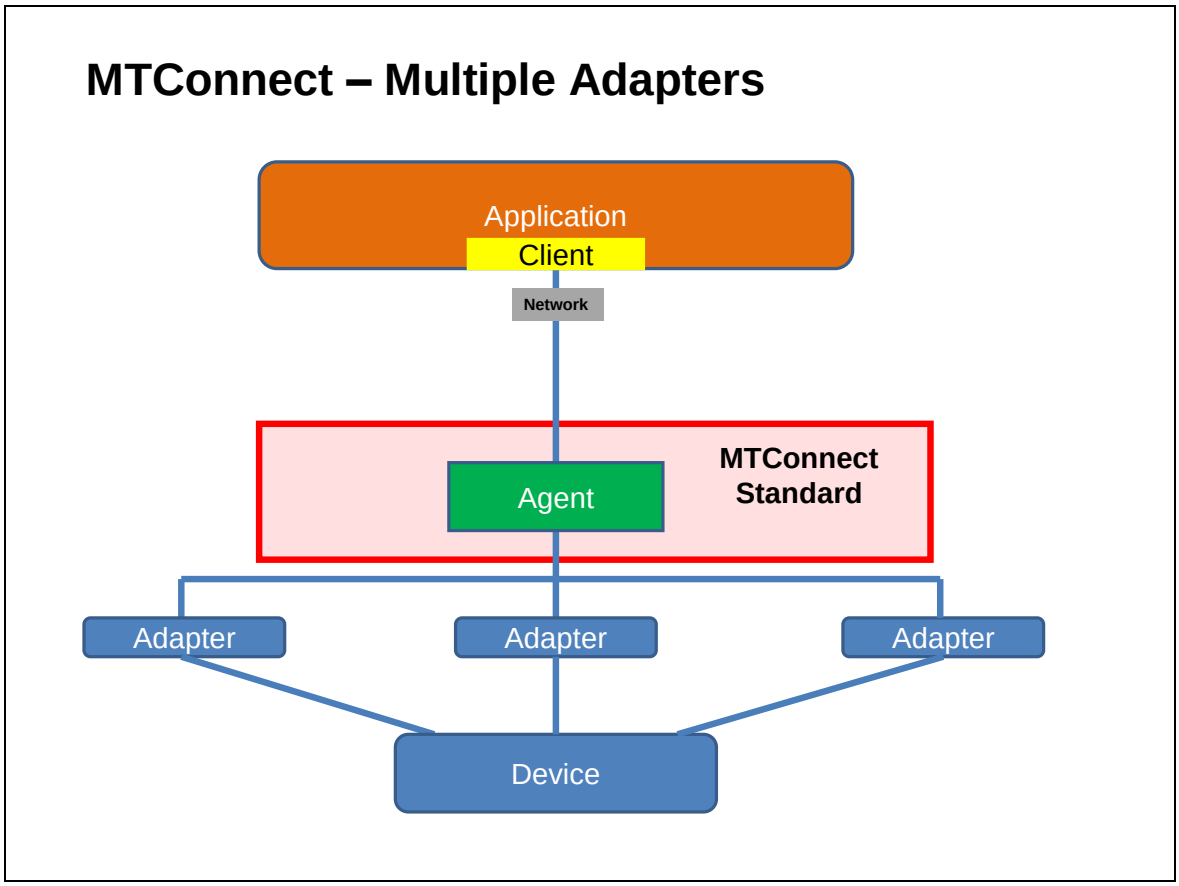

Figure 4 – Multiple Adapters

Namespaces

In Version 1.1 of the MTConnect standard, every XML Document contains one and only one root element. In the case of MTConnect, it is the `MTConnectDevices`, `MTConnectStreams`, or `MTConnectError` element.

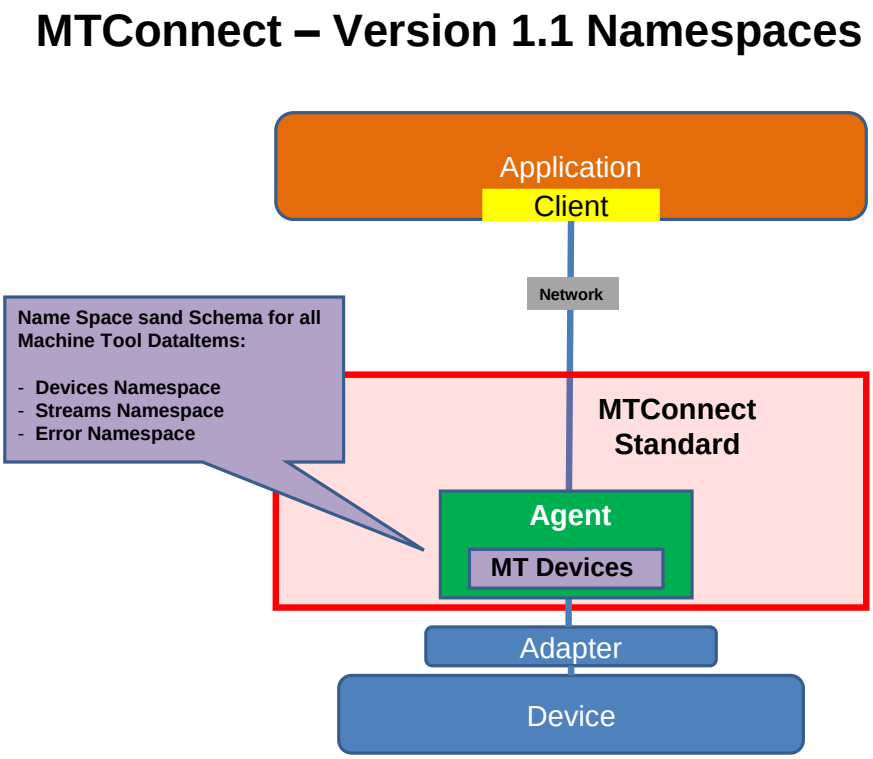

Figure 5 – Version 1.1 Namespaces

In Version 1.2, a new Part 4 is added bringing into view the concept of Mobile Assets.

A Mobile Asset is something that is associated with the manufacturing process that is not a component of a device, can be removed without detriment to the function of the device, and can be associated with other devices during their lifecycle. An asset does not have computational capabilities, but may acquire data that can be associated with it and can even carry information in some media physically attached to the asset.

Concrete examples of Assets are things like Parts, Cutting Tools, Workholding Systems, and Fixtures. Part 4 of the MTConnect standard is concerned with the modeling of these type assets and the management and communication of asset data.

To develop the schema associated with Mobile Assets, the use of a new namespace is necessary. Therefore, with the release of version 1.2 of the standard, there are four namespaces: `MTConnectDevices`, `MTConnectStreams`, `MTConnectAssets`, and `MTConnectError`. This is illustrated in Figure 6 below.

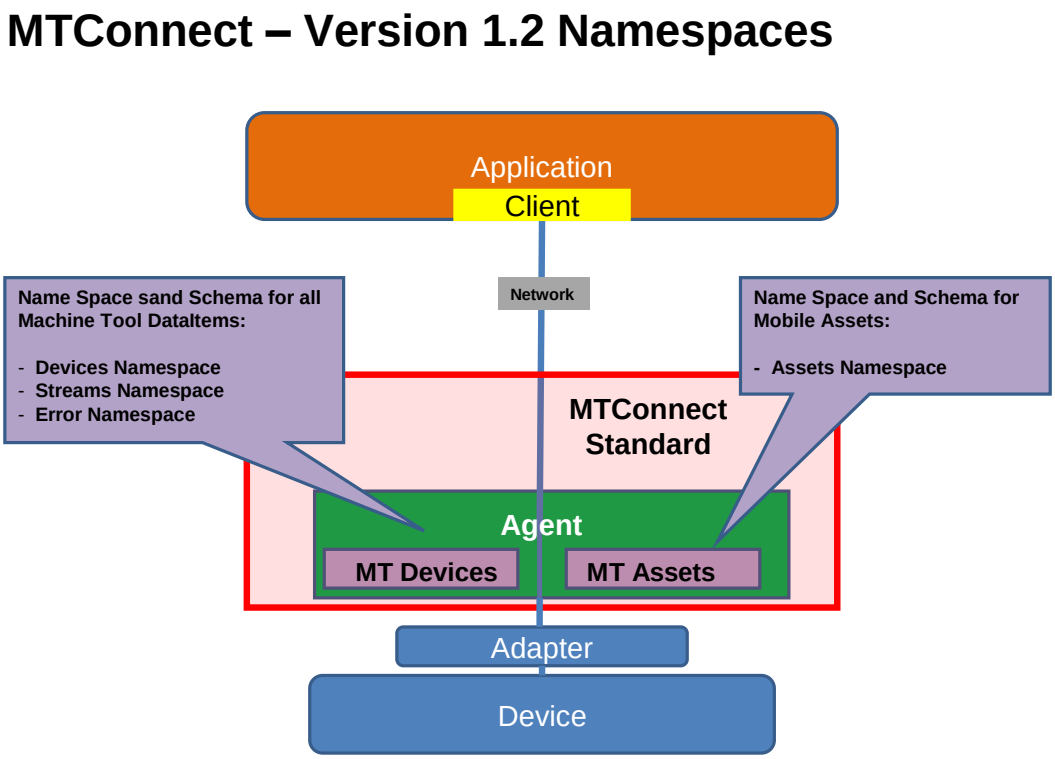

Figure 6 – Version 1.2 Namespaces

MTConnect is an XML based standard and can be extended for use beyond the current definition.

Resources

Version 1.2 of the MTConnect Standard: mtconnect.org/getting-started/developers/standards.aspx

Questions: MTConnectForum.com