MTConnect Specification and Materials

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1 Purpose of This Document

This document, *MTConnect Standard: Part 4.0 - Assets Information Model* of the MTConnect Standard, details information that is common to all types of *MTConnect Assets*. Part 4.0 and its sub-parts of the MTConnect Standard provide semantic models for entities that are used in the manufacturing process, but are not considered to be a piece of equipment. These entities are defined as *MTConnect Assets*. These Assets may be removed from a piece of equipment without detriment to the function of the equipment and can be associated with other pieces of equipment during their lifecycle. The data associated with these Assets may be retrieved from multiple sources that are each responsible for providing their knowledge of the Asset.
2 Terminology and Conventions

Refer to Section 2 of *MTConnect Standard Part 1.0 - Overview and Fundamentals* for a dictionary of terms, reserved language, and document conventions used in the MTConnect Standard.

2.1 Glossary

CDATA

**General meaning:**
An abbreviation for Character Data.

CDATA is used to describe a value (text or data) published as part of an XML element.

For example, "This is some text" is the **CDATA** in the XML element:

```
<Message ...>This is some text</Message>
```

Appears in the documents in the following form: **CDATA**

NMTOKEN

The data type for XML identifiers.

**Note:** The identifier must start with a letter, an underscore "_" or a colon. The next character must be a letter, a number, or one of the following ".", ",", ",", ":". The identifier must not have any spaces or special characters.

Appears in the documents in the following form: **NMTOKEN**

Agent

Refers to an MTConnect Agent.

Software that collects data published from one or more piece(s) of equipment, organizes that data in a structured manner, and responds to requests for data from client software systems by providing a structured response in the form of a **Response Document** that is constructed using the **semantic data models** defined in the Standard.

Appears in the documents in the following form: **Agent**

Asset

**General meaning:**

Typically referred to as an *MTConnect Asset.*
An **MTConnect Asset** is something that is used in the manufacturing process, but is not permanently associated with a single piece of equipment, can be removed from the piece of equipment without compromising its function, and can be associated with other pieces of equipment during its lifecycle.

**Used to identify a storage area in an** [Agent](#).

See description of [buffer](#).

**Used as an** [Information Model](#).

Used to describe an [Information Model](#) that contains the rules and terminology that describe information that may be included in electronic documents representing **MT-Connect Assets**.

The **Asset Information Models** defines the structure for the **Assets Response Document**.

Individual [Information Models](#) describe the structure of the **Asset Documents** that represent each type of **MTConnect Asset**. Appears in the documents in the following form: **Asset Information Models** or (asset type) [Information Model](#).

**Used when referring to an** [MTConnect Asset](#):

Refers to the information related to an **MTConnect Asset** or a group of **MTConnect Assets**.

Appears in the documents in the following form: [Asset](#) or [Assets](#).

**Used as an XML container or element:**

- **When used as an XML container that consists of one or more types of** [Asset](#) XML elements.
  
  Appears in the documents in the following form: **Assets**.

- **When used as an abstract XML element. It is replaced in the XML document by types of** [Asset](#) elements representing individual [Asset](#) entities.
  
  Appears in the documents in the following form: **Asset**.

**Used to describe information stored in an** [Agent](#):

Identifies an electronic document published by a data source and stored in the **assets buffer** of an [Agent](#).

Appears in the documents in the following form: **Asset Document**.

**Used as an XML representation of an** **MTConnect Response Document**:

Identifies an electronic document encoded in XML and published by an [Agent](#) in response to a [Request](#) for information from a client software application relating to **MTConnect Assets**.

Appears in the documents in the following form: **MTConnectAssets**.
Used as an **MTConnect Request**:  
Represents a specific type of communications request between a client software application and an *Agent* regarding *MTConnect Assets*.  
Appears in the documents in the following form: *Asset Request*.

Used as part of an **HTTP Request**:  
Used in the path portion of an **HTTP Request Line** by a client software application, to initiate an *Asset Request* to an *Agent* to publish an *MTConnectAssets* document.  
Appears in the documents in the following form: *asset*.

**Asset Document**  
An electronic document published by an *Agent* in response to a *Request* for information from a client software application relating to Assets.

**buffer**  
*General meaning*:  
A section of an *Agent* that provides storage for information published from pieces of equipment.  
*Used relative to Streaming Data*:  
A section of an *Agent* that provides storage for information relating to individual pieces of *Streaming Data*.  
Appears in the documents in the following form: *buffer*.  
*Used relative to MTConnect Assets*:  
A section of an *Agent* that provides storage for *Asset Documents*.  
Appears in the documents in the following form: *assets buffer*.

**Data Entity**  
A primary data modeling element that represents all elements that either describe data items that may be reported by an *Agent* or the data items that contain the actual data published by an *Agent*.  
Appears in the documents in the following form: *Data Entity*.

**Document**  
*General meaning*:  
A piece of written, printed, or electronic matter that provides information.  
*Used to represent an MTConnect Document*.
Refers to printed or electronic document(s) that represent a Part(s) of the MTConnect Standard.

Appears in the documents in the following form: \textit{MTConnect Document}

Used to represent a specific representation of an \textit{MTConnect Document}

Refers to electronic document(s) associated with an \textit{Agent} that are encoded using XML: \textit{Response Documents} or \textit{Asset Documents}.

Appears in the documents in the following form: \textit{MTConnect XML Document}

Used to describe types of information stored in an \textit{Agent}

In an implementation, the electronic documents that are published from a data source and stored by an \textit{Agent}

Appears in the documents in the following form: \textit{Asset Document}

Used to describe information published by an \textit{Agent}

A document published by an \textit{Agent} based upon one of the \textit{semantic data models} defined in the MTConnect Standard in response to a request from a client.

Appears in the documents in the following form: \textit{Response Document}

\subsection*{Equipment Metadata}

See \textit{Metadata}

\subsection*{HTTP Request}

In the MTConnect Standard, a communications command issued by a client software application to an \textit{Agent} requesting information defined in the \textit{HTTP Request Line}

Appears in the documents in the following form: \textit{HTTP Request}

\subsection*{HTTP Request Line}

In the MTConnect Standard, the first line of an \textit{HTTP Request} describing a specific \textit{Response Document} to be published by an \textit{Agent}

Appears in the documents in the following form: \textit{HTTP Request Line}

\subsection*{Information Model}

The rules, relationships, and terminology that are used to define how information is structured.

For example, an information model is used to define the structure for each \textit{MTConnect Response Document}; the definition of each piece of information within those documents and the relationship between pieces of information.

Appears in the documents in the following form: \textit{Information Model}
**MTConnect Document**

See [Document](##).

**MTConnect Request**

A communication request for information issued from a client software application to an [Agent](##).

Appears in the documents in the following form: [MTConnect Request](##).

**MTConnect XML Document**

See [Document](##).

**Request**

A communications method where a client software application transmits a message to an [Agent](##). That message instructs the [Agent](##) to respond with specific information.

Appears in the documents in the following form: [Request](##).

**Response Document**

See [Document](##).

**semantic data model**

A methodology for defining the structure and meaning for data in a specific logical way.

It provides the rules for encoding electronic information such that it can be interpreted by a software system.

Appears in the documents in the following form: [semantic data model](##).

**Streaming Data**

The values published by a piece of equipment for the [Data Entities](##) defined by the [Equipment Metadata](##).

Appears in the documents in the following form: [Streaming Data](##).

**Valid Data Value**

One or more acceptable values or constrained values that can be reported for a [Data Entity](##).

Appears in the documents in the following form: [Valid Data Value](##)(s).
2.2 Acronyms

AMT
The Association for Manufacturing Technology

2.3 MTConnect References

3 MTConnect Assets

3.1 Overview

The MTConnect Standard supports a simple distributed storage mechanism that allows applications and equipment to share and exchange complex information models in a similar way to a distributed data store. The Asset Information Model associates each electronic MTConnectAssets document with a unique identifier and allows for some predefined mechanisms to find, create, request, updated, and delete these electronic documents in a way that provides for consistency across multiple pieces of equipment.

The protocol provides a limited mechanism of accessing MTConnect Assets using the following properties: assetId, Asset type (element name of Asset root), and the piece of equipment associated with the Asset. These access strategies will provide the following services and answer the following questions: What Assets are from a particular piece of equipment? What are the Assets of a particular type? What Asset is stored for a given assetId?

Although these mechanisms are provided, an Agent should not be considered a data store or a system of reference. The Agent is providing an ephemeral storage capability that will temporarily manage the data for applications wishing to communicate and manage data as needed by the various processes. An application cannot rely on an Agent for long term persistence or durability since the Agent is only required to temporarily store the Asset data and may require another system to provide the source data upon initialization. An Agent is always providing the best-known equipment centric view of the data given the limitations of that piece of equipment.

Note: Currently only cutting tools have been addressed by the MTConnect Standard and other MTConnect Assets will be defined in later versions of the Standard.
3.2 MTConnectAssets

At the top level of the MTConnectAssets document is a standard header, as stated in MTConnect Standard Part 1.0 - Overview and Fundamentals, and one or more MTConnect Assets. Each Asset is required to have an assetId that serves as a unique identifier of that Asset. assetId allows an application to request the Asset data from an Agent.

In the remaining Part 4.x sub-part documents of MTConnect Assets, various types of Assets will be introduced such as cutting tools and other Asset types. Currently only cutting tools have been defined in MTConnect Standard: Part 4.1 - Cutting Tools.

3.2.1 MTConnectAssets Header

The MTConnectAssets header is where the protocol sequence information MUST be provided. The XML schema in Figure 1 represents the structure of the MTConnectAssets header showing the attributes defined for MTConnectAssets.
Refer to *MTConnect Standard Part 1.0 - Overview and Fundamentals* for more information on headers.

![Diagram of MTConnectAssets Header]

**Figure 2:** MTConnectAssets Header

### 3.2.1.1 Header Attributes

*Table [1]* defines the attributes used to provide information for an MTConnectAssets header.

---

MTConnect Part 4.0: Assets Information Model - Version 1.5.0

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Table 1: MTConnectAssets Header

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
<th>Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>version</td>
<td>The protocol version number. This is the <strong>major</strong> and <strong>minor</strong> version number of the MTConnect Standard being used. For example, if the version number of the Standard used is 10.21.33, the <strong>version</strong> will be 10.21. <strong>version</strong> is a required attribute.</td>
<td>1</td>
</tr>
<tr>
<td>creationTime</td>
<td>The time the response was created. <strong>creationTime</strong> is a required attribute.</td>
<td>1</td>
</tr>
<tr>
<td>testIndicator</td>
<td>Optional flag that indicates the system is operating in test mode. This data is only for testing and indicates that the data is simulated. <strong>testIndicator</strong> is an optional attribute.</td>
<td>0..1</td>
</tr>
<tr>
<td>instanceId</td>
<td>A number indicating which invocation of the <strong>Agent</strong>. This is used to differentiate between separate instances of the <strong>Agent</strong>. This value <strong>MUST</strong> have a maximum value of $2^{64} - 1$ and <strong>MUST</strong> be stored in an unsigned 64-bit integer. <strong>instanceId</strong> is a required attribute.</td>
<td>1</td>
</tr>
<tr>
<td>sender</td>
<td>The <strong>Agent</strong> identification information. <strong>sender</strong> is a required attribute.</td>
<td>1</td>
</tr>
<tr>
<td>assetBufferSize</td>
<td>The maximum number of <strong>MTConnect Assets</strong> that will be retained by the <strong>Agent</strong>. The <strong>assetBufferSize</strong> <strong>MUST</strong> be an unsigned positive integer value with a maximum value of $2^{32} - 1$. <strong>assetBufferSize</strong> is a required attribute.</td>
<td>1</td>
</tr>
<tr>
<td>assetCount</td>
<td>The total number of <strong>MTConnect Assets</strong> in an <strong>Agent</strong>. This <strong>MUST</strong> be an unsigned positive integer value with a maximum value of $2^{32} - 1$. This value <strong>MUST NOT</strong> be greater than <strong>assetBufferSize</strong>. <strong>assetCount</strong> is a required attribute.</td>
<td>1</td>
</tr>
</tbody>
</table>
Example 1: MTConnectAssets Header Example

```
<Header creationTime="2010-03-13T07:59:11+00:00"
sender="localhost" instanceId="1268463594"
assetBufferSize="1024" version="1.1"
assetCount="12" />
```

3.2.2 Assets

Assets is an XML container used to group information about various MTConnect Asset types. Assets contains one or more Asset XML elements.

Table 2: MTConnect Assets Element

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
<th>Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assets</td>
<td>An XML container that consists of one or more types of Asset XML elements.</td>
<td>0..1</td>
</tr>
</tbody>
</table>

3.2.3 Asset

An Asset XML element is a container type XML element used to organize information describing an entity that is not a piece of equipment. Asset is an abstract type XML element and will never appear directly in the MTConnect XML document. As an abstract type XML element, Asset will be replaced in the XML document by specific MTConnect Asset type.

Table 3: MTConnect Asset Element

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
<th>Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asset</td>
<td>An abstract XML element. Replaced in the XML document by types of Asset elements representing entities that are not pieces of equipment. There can be multiple types of Asset XML elements in the document.</td>
<td>1..*</td>
</tr>
</tbody>
</table>

There are various types of entities or Asset types. Each type of Asset is described in sub-parts of MTConnect Standard: Part 4.0 - Assets Information Model. These sub-parts are
designated by a Part 4.x document number. Currently only the MTConnect Asset type of cutting tools has been defined in MTConnect Standard: Part 4.1 - Cutting Tools.

For all MTConnect Asset types there are some common attributes and elements that apply to all of them. The following defines these common attributes and elements.

### 3.2.3.1 Common Asset Attributes

The XML schema in Figure 3 represents the structure of Asset showing the attributes defined for Asset.

![Figure 3: Asset Schema](image)

Table 4 defines the attributes that are used to provide information for the Asset element.

**Table 4: Attributes for Asset**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
<th>Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>assetId</td>
<td>The unique identifier for the MTConnect Asset. The identifier <strong>MUST</strong> be unique with respect to all other Assets in an MTConnect installation. The identifier <strong>SHOULD</strong> be globally unique with respect to all other Assets assetId is a required attribute.</td>
<td>1</td>
</tr>
</tbody>
</table>
### Continuation of Table 4

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
<th>Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>timestamp</td>
<td>The time this <em>MTConnect Asset</em> was last modified. Always given in UTC.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>The <em>timestamp</em> <strong>MUST</strong> be provided in UTC (Universal Time Coordinate, also</td>
<td></td>
</tr>
<tr>
<td></td>
<td>known as GMT). This is the time the <em>Asset</em> data was last modified.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>timestamp</em> is a required attribute.</td>
<td></td>
</tr>
<tr>
<td>deviceUuid</td>
<td>The piece of equipments UUID that supplied this data. This is an optional</td>
<td>0..1</td>
</tr>
<tr>
<td></td>
<td>element references to the UUID attribute given in the <em>Device</em> element.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>This can be any series of numbers and letters as defined by the XML type</td>
<td></td>
</tr>
<tr>
<td></td>
<td>NMTOKEN.</td>
<td></td>
</tr>
<tr>
<td>removed</td>
<td>This is an optional attribute that is an indicator that the <em>MTConnect Asset</em></td>
<td>0..1</td>
</tr>
<tr>
<td></td>
<td>has been removed from the piece of equipment. If the <em>Asset</em> is marked as</td>
<td></td>
</tr>
<tr>
<td></td>
<td>removed, it will not be visible to the client application unless the=true</td>
<td></td>
</tr>
<tr>
<td></td>
<td>parameter is provided in the URL. If this attribute is not present it <strong>MUST</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>be assumed to be false. The value is an xsi:boolean type and <strong>MUST</strong> be true</td>
<td></td>
</tr>
<tr>
<td></td>
<td>or false.</td>
<td></td>
</tr>
</tbody>
</table>

All *MTConnect Assets** **MUST** have an *assetId* that differs from all the other *Assets* in a facility and preferably globally unique, such as a RFC 4122 UUID. There **MUST** never be more than one *Asset* provided by an *Agent* with the same *assetId* in the same shop.

The following attributes **MUST** be provided and are common to all *MTConnect Asset* types: the *assetId* attribute providing the unique identifier for the *Asset*, and the *timestamp* providing the time the *Asset* was inserted or updated. A removed flag that if **true** indicates the *Asset* has been removed (deleted) from the equipment is optional, however the *Asset* will still be available if requested directly or a request is made that includes removed *Assets*.

An *MTConnectAssets* document contains information pertaining to something that is not a direct component of the piece of equipment and can be relocated to another piece of equipment or location during its lifecycle. The *Asset* will contain data that will be changed as a unit, meaning that at any given point in time the latest version of the complete state for this *Asset* will be provided.
Each piece of equipment or location may have a different view of this Asset and it is the responsibility of an application to collect and determine the aggregate information and keep a historical record if required. An Agent will allow any application or other equipment to request this information. The piece of equipment MUST supply the latest and most accurate information regarding a given Asset.

### 3.2.3.2 Common Asset Elements

The element Description is the only element common to all Asset types. The XML schema in Figure 4 represents the structure of Description.

![Figure 4: Description Schema](image)

**Table 5**: Elements for Asset

<table>
<thead>
<tr>
<th>Elements</th>
<th>Description</th>
<th>Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>An optional element that can contain any descriptive content. This can contain configuration information and manufacturer specific details. This element is defined to contain mixed content and XML elements can be added to extend the descriptive semantics of MTConnect Standard.</td>
<td>0..1</td>
</tr>
</tbody>
</table>
4 MTConnect Assets Architecture

4.1 Agent Asset Storage

The Agent stores MTConnect Assets in a similar fashion as the Agent data storage described in MTConnect Standard Part 1.0 - Overview and Fundamentals. The storage of information is contained in the asset buffer. The Agent provides a limited number of Assets that can be stored at one time and uses the same method of pushing out the oldest Asset when the asset buffer is full. The asset buffer size for the Asset storage is maintained separately from the Sample, Event, and Condition storage.

Figure 5: MTConnect Assets storage as First in First Out

MTConnect Assets also behave like a key/value in memory database. In the case of the Asset, the key is the assetId and the value is the XML document describing the Asset. The key can be any string of letters, punctuation or digits and represent the domain specific coding scheme for their assets. Each Asset type will have a recommended way to construct a unique assetId, for example, a cutting tool SHOULD be identified by the tool ID and serial number as a composed synthetic identifier.
As in Figure 6, each of the Assets is referred to by their key. The key is independent of the order in the asset buffer storage.

4.2 Asset Protocol

MTConnect Standard provides methods to retrieve an MTConnect Asset or a set of Assets given various criteria. These criteria are as follows: The assetId, the Asset type as defined by the name of the Asset’s topmost element, and the originating piece of equipment. The URL format is similar to the probe and sample structure. Reference each assetId directly to request an MTConnect Asset by assetId.

4.2.1 Asset by assetId

Example 2: Asset by assetId Example

1  url: http://example.com/asset/e39d23ba-ef2d-11e6-b12c15028cfe91a82ef
2 11e6-b12c15028cfe91a82ef
Example 2 returns the MTConnectAssets document for Asset e39d23ba-ef2d-11e6-b12c-28cfe91a82ef

Request multiple Assets by each assetId:

Example 3: Assets by assetId Example

1 url: http://example.com/asset/e39d23ba-ef2d-11e6-b12c-155
2 8cfe91a82ef;e46d5256-ef2d-11e6-96aa-28cfe91a82ef

Example 3 returns the MTConnectAssets document for Assets e39d23ba-ef2d-11e6-b12c-28cfe91a82ef and e46d5256-ef2d-11e6-96aa-28cfe91a82ef.

Request for all the Assets in the Agent:

Example 4: Get all Assets Example

1 url: http://example.com/assets

Example 4 returns all available MTConnect Assets in the Agent. The Agent MAY return a limited set if there are too many Asset records. The Assets MUST be added to the beginning with the most recently modified Asset.

4.2.2 Asset for a Given Type

Example 5: Asset for a Given Type Example

1 url: http://example.com/assets?type="CuttingTool"

Example 5 returns all available CuttingTool Assets from the Agent of the type CuttingTool. The Agent MAY return a limited set if there are too many Asset records. The Assets MUST be added to the beginning with the most recently modified assets.

Request for all Assets of a given type in the Agent up to a maximum count:

Example 6: Asset for a Given Type with Maximum count Example

1 url: http://example.com/assets?type="CuttingTool"

Example 6 returns all available CuttingTool Assets from the Agent. The Agent MUST return up to 1000 Assets beginning with the most recently modified Assets if they exist.

4.2.3 Assets Including Removed Assets

Example 7: Assets Including Removed Assets Example

1 url: http://example.com/assets?type=CuttingTool&removed=true
Example 7 returns all available CuttingTool Assets from the Agent. With the removed flag, Assets that have been removed but are included in the result set.

4.2.4 Assets for a Piece of Equipment

If no assetId is provided with a general Assets request, it would be as shown in Example 8:

Example 8: Assets For a Piece of Equipment Example

url: http://example.com/Mill123/assets

All MTConnect Assets will be provided for that piece of equipment (Device) up to the Agent's maximum count or as specified with the count parameter. These Assets will be returned starting from the newest to oldest list.

Any of the previous constraints can also be applied to the request, for example, to get all the CuttingTool instances for a given piece of equipment:

Example 9: Assets For a Piece of Equipment For a Given Type Example

url: http://example.com/Mill123/asset/
?type=CuttingTool&count=100

The request in Example 9 will get the newest 100 Cutting Tool Instance Assets from the Agent for Mill123. Similarly:

Example 10: Assets For a Piece of Equipment For a Given Type Example 2

url: http://example.com/Mill123/asset/
?type=CuttingToolArchetype

Example 10 will provide all Cutting Tool Archetype Assets with the deviceUuid of Mill123.
5 Extensions to Part 2.0 - Devices Information Model

This document will add the following data item types to support change notification when an MTConnect Asset is added or updated. The data item MUST be placed in the DataItems container associated with Device. The Device MUST be the piece of equipment that is supplying the asset data.

5.1 Data Item Types added for EVENT Category

Table 6: DataItem Type for EVENT category

<table>
<thead>
<tr>
<th>DataItem Type SubType</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSET_CHANGED</td>
<td>The value of the CDATA for the event MUST be the assetId of the asset that has been added or changed. There will not be a separate message for new assets.</td>
</tr>
<tr>
<td>ASSET_REMOVED</td>
<td>The value of the CDATA for the event MUST be the assetId of the asset that has been removed. The asset will still be visible if requested with the includeRemoved parameter as described in the protocol section. When assets are removed they are not moved to the beginning of the most recently modified list.</td>
</tr>
</tbody>
</table>

5.1.1 ASSET_CHANGED Data Item Type

When an MTConnect Asset is added or modified, an AssetChanged event MUST be published to inform an application that new asset data is available. The application can request the new asset data from the piece of equipment at that time. Every time the asset data is modified an AssetChanged event will be published. Since the asset data is a complete electronic document, the system will publish a single AssetChanged event for the entire set of changes.

The asset data MUST remain constant until the AssetChanged event is published. Once it is published the data MUST change to reflect the new content at that instant. The timestamp of the asset will reflect the time the last change was made to the asset data.
5.1.2 ASSET_REMOVED Data Item Type

When an MTConnect Asset has been removed from an Agent or marked as removed, an AssetRemoved event MUST be generated in a similar way to the AssetChanged event. The CDATA of the AssetRemoved event MUST contain the assetId that was just removed.

Every time an MTConnect Asset is modified or added it will be moved to the beginning of the asset buffer and become the newest Asset. As the asset buffer fills up, the oldest Asset will be pushed out and its information will be removed. The MTConnect Standard does not specify the maximum size of the asset buffer, and if the implementation desires, permanent storage MAY be used to store the Assets. A value of 4,294,967,296 or \(2^{32}\) can be given to indicate unlimited storage.

There is no requirement for persistent Asset storage. If the Agent fails, all existing MT-Connect Assets MAY be lost. It is the responsibility of the implementation to restore the lost Asset data and it is the responsibility of the application to persist the Asset data. The Agent MAY make no guarantees about availability of Asset data after the Agent stops.
6 Extensions to Part 3.0 - Streams Information Model

The associated modifications MUST be added to MTConnect Standard: Part 3.0 - Streams Information Model to add the following event to the Events in the streams.

6.1 AssetChanged Extension to Events

The AssetChanged element extends the base Event type XML data element defined in MTConnect Standard: Part 3.0 - Streams Information Model and adds the assetType attribute to the base Event. This new Event will signal whenever a new MTConnect Asset is added or the existing definition of an Asset is updated. The assetId is provided as the CDATA value and can be used to request the Asset data from the Agent.

Figure 7: AssetChanged Schema

AssetChanged: An MTConnect Asset has been added or modified. The CDATA for the AssetChanged element MUST be the assetId of the Asset that has been modified.
### 6.1.1 AssetChanged event Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
<th>Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>assetType</td>
<td>The type of asset changed.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>assetType is a required attribute.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Valid Data Values</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cutting Tool</td>
<td></td>
</tr>
</tbody>
</table>

### 6.2 AssetRemoved Extension to Events

**Figure 8:** AssetRemoved Schema

AssetRemoved: An *MTConnect Asset* has been removed. The [CDATA] for the AssetRemoved element MUST be the assetId of the [Asset] that has been removed.
6.2.1 AssetRemoved Attributes

Table 8: Attributes for AssetRemoved

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
<th>Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>assetType</td>
<td>The type of asset that was removed.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>assetType is a required attribute.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Valid Data Values</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cutting Tool</td>
<td></td>
</tr>
</tbody>
</table>

The *MTConnect Asset* will still be available if requested if the removed=true argument is supplied. The **assetId** is provide as the **CDATA** value and can be used to request the **Asset** data from the **Agent**.
Appendices

A Bibliography


