MCOSMOS – CMM Status Monitor

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Contents

1 General

In the following a service is presented, which is used to observe the status of coordinate measurement machines. We refer to it as 'the service'. MCOSMOS reports its actual status to this service. The status can be retrieved by clients over a network. This allows having an overview of the status of several CMMs in a one place.

1.1 Terminology

CMM: Coordinate Measurement Machine

MCAdapter/MCAgent:
Components which are needed to provide the service to MTConnect Protocol clients.

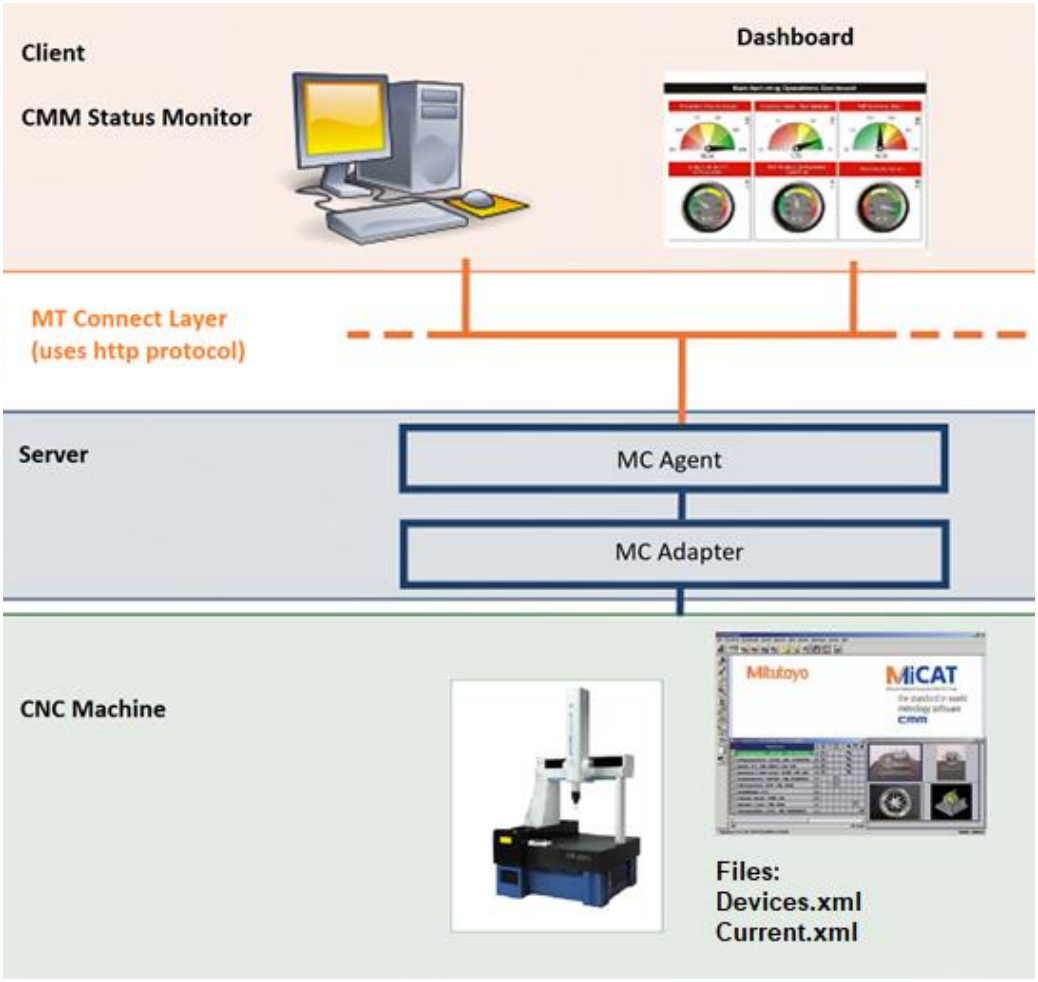
MTConnect:
MTConnect is a manufacturing technical standard to retrieve process information from numerically controlled machine tools.[1]

XML:
XML is a markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable.[2]

[1] https://en.wikipedia.org/wiki/MTConnect
[2] https://en.wikipedia.org/wiki/XML

1.2 Purpose of the service

The service enhances the status data acquisition capability from a CMM. The service consists of the MCAdapter and MCAgent as well as an MCOMOS DLL and uses the MTConnect protocol. A client may connect remotely to the service to get status information.



2 Installation

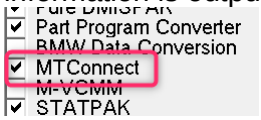
Precondition:

- **Windows .NET 4 Framework** is installed.
- **User permissions** allow installation of this service

2.1 Dongle option

At least MCOSMOS v3.5.R5 or MCOSMOS v4.0.R2 are needed.

Up to MCOSMOS v4.2, the dongle option "MTConnect" is necessary to send the extended status information. Only if this dongle option is available, the additional status information is output.



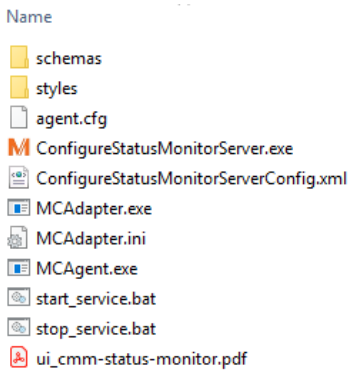
Since MCOSMOS v4.3 the dongle option is not necessary anymore.

2.2 Recommended steps for installation of the server

The files installed automatically with the MCOSMOS installation are:
..\DLL\MnSendMcosmosStatus.DLL
..\UDL\ExtendedStatusInfo.udl

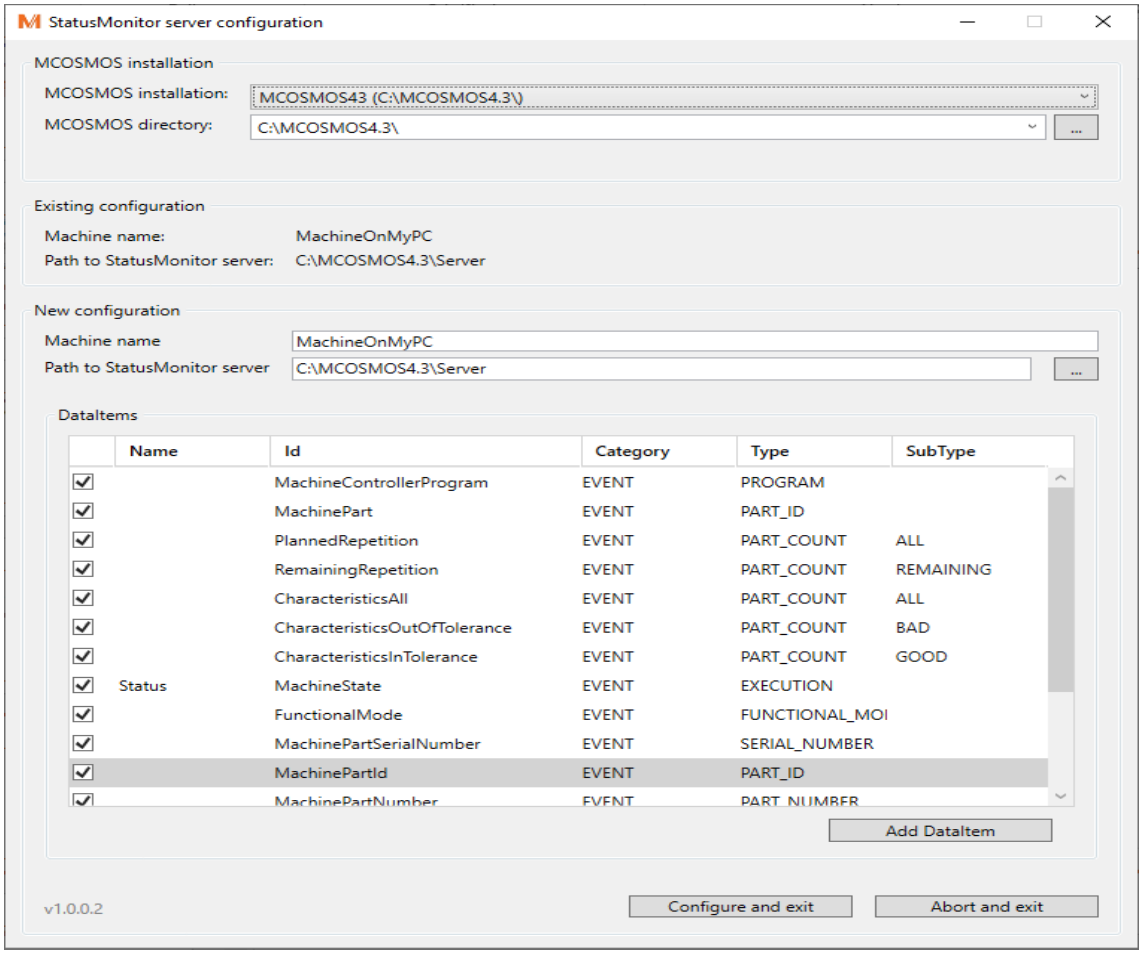
For the installation of the server, it is necessary to install further files manually.

Provided files in the Server folder of the archive are:



Copy the files above to a separate local folder (e. g. C:\MCOSMOS4.3\Server) on each computer, where the server is supposed to run.

The next step is to run the tool ConfigureStatusMonitorServer.exe from the above folder.
Make sure the ConfigureStatusMonitorServerConfig.xml file is in the same directory.



Within this tool

1. Select the MCOSMOS installation or MCOSMOS directory.
2. Enter a name for the machine and input the path to the server (C:\MCOSMOS4.3\Server in our example above)
3. Select the DataItems (i. e. status data) which should be output via MTConnect.

The tool configures the Geowin.ini file and generates the Devices.xml file in the server folder (see GEOWINI.INI and Devices.xml below).

To test the installation quickly, start start_service.bat from the server folder. MCAdapter and MCAgent are started automatically. You can check this in the Windows TaskManager (see below).

MCAdapter.exe

MCAgent.exe *32

For other possibilities to test the service, see further below.

Excerpts from example Geowin.ini and Devices.xml files

Devices.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<MTConnectDevices
                            xmlns:m="urn:mtconnect.org:MTConnectDevices:1.3"
                            xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                            xmlns="urn:mtconnect.org:MTConnectDevices:1.3"
                            xsi:schemaLocation="urn:mtconnect.org:MTConnectDevices:1.3 http://www.mtconnect.org/schemas/MTConnectDevices_1.3.xsd">
  <Devices>
    <Device id="MachineOnMyPC" name="MachineOnMyPC" uuid="MachineOnMyPC">
      <Description manufacturer="Mitutoyo"/>
      <DataItems>
                        <DataItem category="EVENT" id="MachineControllerProgram" name="" type="PROGRAM"/>
                        <DataItem category="EVENT" id="MachinePart" name="" type="PART_ID"/>
                        <DataItem category="EVENT" id="PlannedRepetition" name="" type="PART_COUNT" subType="ALL"/>
                        <DataItem category="EVENT" id="RemainingRepetition" name="" type="PART_COUNT" subType="REMAINING"/>
                        <DataItem category="EVENT" id="CharacteristicsAll" name="" type="PART_COUNT" subType="ALL"/>
                        <DataItem category="EVENT" id="CharacteristicsOutOfTolerance" name="" type="PART_COUNT" subType="BAD"/>
                        <DataItem category="EVENT" id="CharacteristicsInTolerance" name="" type="PART_COUNT" subType="GOOD"/>
                        <DataItem category="EVENT" id="MachineState" name="Status" type="EXECUTION"/>
                        <DataItem category="EVENT" id="FunctionalMode" name="" type="FUNCTIONAL_MODE"/>
                        <DataItem category="EVENT" id="MachinePartSerialNumber" name="" type="SERIAL_NUMBER"/>
                        <DataItem category="EVENT" id="MachinePartId" name="" type="PART_ID"/>
                        <DataItem category="EVENT" id="MachinePartNumber" name="" type="PART_NUMBER"/>
                        <DataItem category="EVENT" id="ControllerMode" name="" type="CONTROLLER_MODE"/>
                        <DataItem category="CONDITION" id="StatusCond" name="" type="PROGRAM"/>
                        <DataItem category="CONDITION" id="StatusCondMotionProgram" name="" type="MOTION_PROGRAM"/>
                        <DataItem category="SAMPLE" id="WORKOFFSET_XYZ_AXIS" name="" type="PATH_POSITION"/>
      </DataItems>
    </Device>
  </Devices>
</MTConnectDevices>
```

Geowin.ini

```
[MCAdapter]
ManualStatus=0
TransferPath=C:\MCOSMOS4.3\Server
MachineName=MachineOnMyPC
```

Autostart

If the MCAdapter should be started automatically when the computer is booted, create a shortcut to start_service.bat in the following directory: C:\Users\<UserName>\AppData\Roaming\Microsoft\Windows\Start Menu\Programs\startup

2.2.1 How to test the service

Display results

The web browser can act as an MTConnect client using the following URLs:
On local computer http://127.0.0.1:5000/current
On other computer http://<IP address>:5000/current

A web page with current values of the selected data items should be displayed.

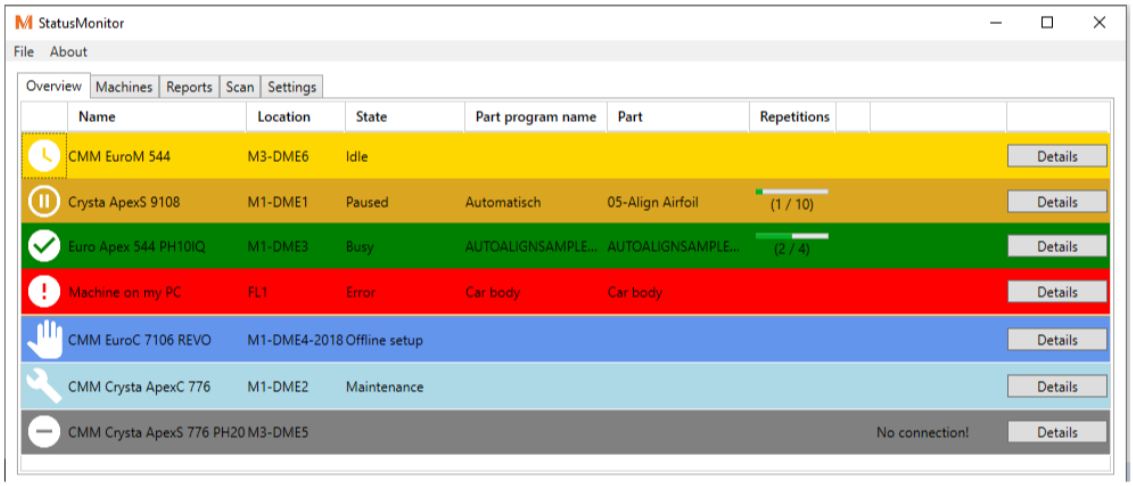
Events

Timestamp	Type	Sub Type	Name	Id	Sequence	Value
2019-06-19T15:38:57.6651726Z	PartCount	ALL		CharacteristicsAll	454	8
2019-06-19T15:38:57.5644111Z	PartCount	GOOD		CharacteristicsInTolerance	453	7
2019-06-19T15:15:43.5137116Z	PartCount	BAD		CharacteristicsOutOfTolerance	22	0
2019-06-19T15:38:55.9471441Z	ControllerMode			ControllerMode	437	AUTOMATIC
2019-06-19T15:15:43.5137116Z	FunctionalMode			FunctionalMode	29	PRODUCTION
2019-06-19T15:38:56.1490580Z	Program		Teileprogramname	MachineControllerProgram	439	MtConnectTest1
2019-06-19T15:15:43.471149Z	AssetChanged			MachineOnMyPC_asset_chg	7	UNAVAILABLE
2019-06-19T15:15:43.471149Z	AssetRemoved			MachineOnMyPC_asset_rem	8	UNAVAILABLE
2019-06-19T15:15:43.502116Z	Availability			MachineOnMyPC_avail	20	AVAILABLE
2019-06-19T15:38:56.0482140Z	PartId		Teilename	MachinePart	438	MtConnectTest1
2019-06-19T15:15:43.471149Z	PartId			MachinePartId	11	UNAVAILABLE
2019-06-19T15:15:43.5137116Z	PartNumber			MachinePartNumber	27	1230
2019-06-19T15:38:20.8801826Z	SerialNumber			MachinePartSerialNumber	429	
2019-06-19T15:38:55.9471441Z	Execution		Status	MachineState	436	ACTIVE
2019-06-19T15:15:43.5137116Z	PartCount	ALL		PlannedRepetition	24	-1
2019-06-19T15:15:43.5137116Z	PartCount	REMAINING		RemainingRepetition	25	0

Condition

Timestamp	Type	Sub Type	Name	Id	Sequence	Value
2019-06-19T15:15:43.5227338Z	Normal			StatusCond	32	
2019-06-19T15:15:43.5227338Z	Normal			StatusCondMotionProgram	33	

Alternatively, CMM Status Monitor or another MTConnect client can be used.



2.3 Installed files

The service consists of adapter/agent binaries and configuration files:

MCAdapter.exe	An application that executes in the 'background'. It reads Devices.xml expecting a special structure. It starts the MCAgent.exe executable.
MCAdapter.ini	INI Configuration for the adapter. See description.
MCAgent.exe	Do not call this application manually – it will be started by MCAdapter.exe. It gets information (machine state) from MCAdapter.exe in case the state has changed, i.e. the XML file mentioned above was modified regarding some data items. It responds to any client connecting to it at port 5000 using the MTConnect protocol.
agent.cfg	This is read by MCAgent.exe to configure it – only change its contents if you know the consequences.
Devices.xml	This defines the machine and the data items to be output over the MTConnect protocol – only change its contents if you know the consequences. **If this file does not exist in the server folder, run the configuration program (see installation steps).** The Device ‘id’, ‘name’ and ‘uuid’ have to be the same as set in the GEOWIN.INI file under ‘MachineName’.

Current.xml	This file contains the current machine state and is read by the MCAdapter.exe. **If the file does not exist, ensure MCOSMOS is configured correctly and execute a part program.**
schemas directory	Contains the schemas for the MTConnect response XML.
styles directory	Contains files to display the MTConnect response in the browser.
start_service.bat	Batch file to start the MTConnect service.
stop_service.bat	Batch file to stop the MTConnect service.
ConfigureStatusMonitorServer.exe	Configuration program used to configure MCOSMOS. This program creates the Devices.xml file and adapts the Geowin.ini file (see above).
ConfigureStatusMonitorServerConfig.xml	Current list of possible data items, used by ConfigureStatusMonitorServer.exe.

3 Settings

Normally, the service is configured by the configuration tool. In case that manual configuration is necessary, the settings shown below should be adjusted.

3.1 Command line parameters for MCAdapter.exe

The MCAdapter has the following command line parameters:

```
MCAdapter.exe [Current.xml] [Devices.xml] [Read period] [MCAgent.exe]
[MCAdapter.ini]
```

Parameter	Description
Current.xml	Path to the Current.xml file which is written to by MCOSMOS
Devices.xml	Path to the Devices.xml file
Read period	Time to wait between reading the Current.xml
MCAgent.exe	Path to the MCAgent.exe file
MCAdapter.ini	Path to the MCAdapter.ini configuration file

3.2 Settings for MCOSMOS (GEOWIN.INI)

Section	Variable	Default	Meaning
MCAdapter	TransferPath	..\TEMP	Path where the Current.xml file is written Must be the same as the current folder, where MCAdapter.exe is running or as specified on the MCAdapter.exe command line. E.g. C:\MCOSMOS4.3\Server
	MachineName	Machine-1	Name of connected CMM **If you adapt this name, it also has to be adapted in the Devices.xml file (see above).**
	ManualStatus	0	Manual status set by PartManager 0: IDLE 1: SETUP 2: PLANNED_MAINTENANCE 3: UNPLANNED_MAINTENANCE

4 Details

4.1 Overview of supported MTConnect data item types

The following data item types are supported in MCOSMOS v4.3. Some of those data item types are described in more detail further below.

Type	SubType	Id	Category	Comment
PROGRAM	-	MachineControllerProgram	Event	Part program name
PART_ID	-	MachinePart	Event	Part name
PART_COUNT	ALL	PlannedRepetition	Event	Planned repetitions
PART_COUNT	REMAINING	RemainingRepetition	Event	Remaining repetitions
PART_COUNT	ALL	CharacteristicsAll	Event	Tolerance comparisons (total)
PART_COUNT	BAD	CharacteristicsOutOfTolerance	Event	Tolerance comparisons (out of tolerance)
PART_COUNT	GOOD	CharacteristicsInTolerance	Event	Tolerance comparisons (in tolerance)
EXECUTION	-	MachineState	Event	Belongs to machine state
FUNCTIONAL_MODE	-	FunctionalMode	Event	Belongs to machine state
SERIAL_NUMBER	-	MachinePartSerialNumber	Event	Output user defined serial number
PART_ID	-	MachinePartId	Event	Output user defined part number
PART_NUMBER	-	MachinePartNumber	Event	Output user defined part number
CONTROLLER_MODE	-	ControllerMode	Event	Belongs to machine state
PROGRAM	-	StatusCond	Condition	Belongs to machine state
MOTION_PROGRAM	-	StatusCondMotionProgram	Condition	Belongs to machine state
PATH_POSITION	-	WORKOFFSET_XYZ_AXIS	Sample	Machine position

4.2 Possible Running States

MCOSMOS outputs its states to the service using three data item types.

Up to MCOSMOS v4.2 the status of the machine was described by numbers. Now, the MachineState event changed to the EXECUTION and FUNCTIONAL_MODE events and a status condition. The events and the condition have the following possible values:

Old status	EXECUTION (Event)	FUNCTIONAL_MODE (Event)	PROGRAM (Condition)
1 - Busy	ACTIVE	PRODUCTION	Normal
2 - Idle	READY	PRODUCTION	Normal
4 - Error	STOPPED	PRODUCTION	Fault HIGH
- - Error (resettable)	INTERRUPTED	PRODUCTION	Fault LOW
8 - Offline Setup		PROCESS_DEVELOPMENT	Normal
16 - Wait	PROGRAM_STOPPED	PRODUCTION	Normal
32 - Maintenance unplanned		MAINTENANCE	Warning HIGH
64 - Maintenance planned		MAINTENANCE	Warning LOW

4.2.1 Which status is set in learn mode?

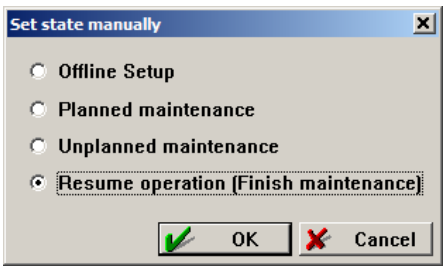
When learn mode is started the status cannot be left as "IDLE" since the machine cannot be used in the automatic cell process. So the status has to be changed while learn mode is running.

The following steps are taken when entering the learn mode:

- ❑ GEOPAK learn mode is started
- ❑ GEOPAK checks the manually set status
- ❑ The change of the status depends on the actual status
  - If the status is "Resume operation (Finish maintenance)", GEOPAK sets the status automatically to "Offline Setup" while learn mode is running.
  - If the status is "Offline Setup" or "Planned or unplanned maintenance", the status is not changed.
- ❑ The user closes GEOPAK learn mode. GEOPAK sets the previous status before starting learn mode.
- ❑ While learn mode is running, the state is not changed.

4.2.2 How to set status manually

The status can be set manually in PartManager in menu "Tools/Set state manually". The user must have the user right "Edit system settings" to open this dialogue.



Once the status was set to "Offline Setup", "Planned maintenance" or “Unplanned maintenance", GEOPAK must not change the status automatically in a part program. The status must first be reset in this dialogue to "Resume operation". After closing this dialogue with the OK button, the new status is set.

The last selection of this dialogue is stored by the PartManager in an INI file. GEOPAK reads this information to check, if it is allowed to change this state.

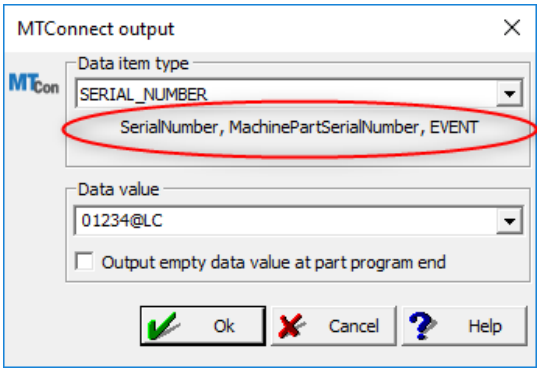
4.3 GEOPAK command "MTConnect output"

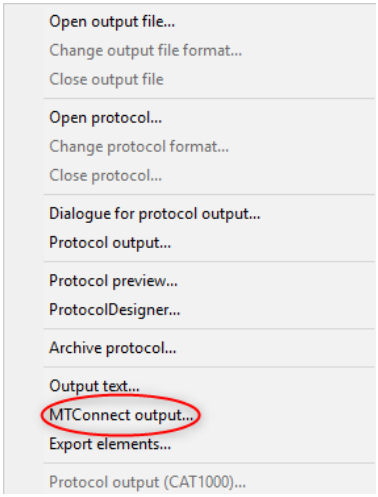
The GEOPAK command "MTConnect output" allows the output of user defined texts. This output is possible since MCOSMOS v4.3.

Events/Conditions

DataItemType	SubType	DataItemId	Category
SERIAL_NUMBER	-	MachinePartSerialNumber	Event
PART_ID	-	MachinePartId	Event
PART_NUMBER	-	MachinePartNumber	Event

Dialogue and menu in GEOPAK





4.4 Position of machine

The output of the machine position could be used e.g. for a so called Digital Twin.

Type	SubType	Id	Category
PATH_POSITION	-	WORKOFFSET_XYZ_AXIS	Sample

Sending the X, Y, Z position of the machine via MTConnect is not a typical requirement. As it could delay the data transfer, it has to be enabled separately using an INI setting.

File MCAdapter.ini
The file is located in the server folder, where MCAdapter.exe is located.

Section	Variable	Default	Meaning
Main	EnablePathPosition	0	Send PATH_POSITION 0: disabled (Default) 1: enabled
Main	UpdatePeriod	100	Update period in milliseconds
Main	TransferPath		Path to Current.xml file
Main	MachineName		Name of the machine

Batch to start MCAdapter.exe
MCAdapter.exe <Name of file Current.xml> <Name of file Devices.xml> <Update period in milliseconds>

Example of start_service.bat:
start MCAdapter.exe Current.xml Devices.xml 100

5 History

Date	Doc. version	Name	Comment
2013-11-27	v1.00	FL/EP	Created, Based on MCOSMOS v3.5 document MCOSMOS-CMM Status Monitor.docx
2019-07-31	v2.00	VM	Revised document