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Writing a Field Device Configuration Utility Using the HART OPC Server

22 March, 1999

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INTRODUCTION

The principle objective of the HART OPC Server is to act as a transport mechanism for communicating with HART devices. The interface via the Server to the device is the same whether the device is connected directly to the PC or connected via some intermediate I/O system. Initially the Server supports: (1) a direct HART connection, (2) Elcon Mux's, (3) Arcom HPort Mux, (3) MTL Mux's and (4) Pepperl+Fuchs Mux's. Different manufacturers multiplexer may even share the same RS-485 serial port. Discussions are underway to add support for several other manufacturer's I/O systems.

While the intermediate I/O systems may vary, the interface to applications using the OPC server remains the same. This paper discusses development of a utility to configure HART field devices through the HART OPC Server. Using the Server to access and configure your device provides significant benefits including:

- No Master Link Layer needs to be developed;
- Support for many multiplexer types are automatically included;
- One version of the utility is required no matter the intermediate I/O systems;
- Development of the configuration utility is dramatically simplified; and
- Access to the field devices is shared. In other words, many client applications can access HART data from the same device or several different devices simultaneously.

OVERVIEW

The Server provides two basic interfaces: the OPC interface; and the HART pass-through interface. The OPC interface complies with the OPC Foundation Specifications. HART Universal and some Common Practice command data is available at this interface. This support provides system integrators with a interoperable and common look for all HART compatible devices. Since this data includes the process related data the Server meets the needs of most SCADA and simple control applications.

The second interface is designed to allow device specific command access. Once the connection to your field device is established any HART command may be built and transmitted. The HART pass-through interface requires only the command number, byte count, and data fields to be provided. Addressing, routing, error checking etc are all performed by the Server. The Server returns the byte count and data from the field device response. The application does not need to know whether it is connected directly to the HART loop or connected through an intermediate I/O system or multiplexer. You do not need to develop special drivers for the different multiplexers.

The simplest development strategy for the configuration utility software uses both interfaces. The procedure for configuring a field device would be:

- Using the OPC interface, allow the user to browse through the connected field devices.
- When the user selects the field device to configure, the OPC interface provides the tag for that field device.
- Using the tag, a connection is made via the HART pass-through interface to the device.
- This connection allows device specific commands to be sent to the field device.
- Once configuration is complete the connection is closed and the configuration utility can exit.

Proper use of the HART tag is required by most host systems including the HART OPC Server. In fact, the OPC Specifications use the tag to connect to and access field device data. Each element in the communication path contains a tag including the network, multiplexer and field device. Of course, HART Universal Commands require the tag to be supported in the field device. All networks must have a different tag. All multiplexers connected to single network must have unique tags and all devices connected to a single multiplexer must have a unique tag. However, two field devices connected to two different multiplexers may have the same tag. When the tags are concatenated together for the network, multiplexer and field device the unique communication path from the server to the field device is created.

CONNECTING TO YOUR FIELD DEVICE

Since the Server will usually be a fixed installation connecting to your device is an important part of your configuration program. The server can support simultaneous access to a large number of devices:

- Each server installation may have several networks. For example, each serial port on the PC could be a network of multiplexers. In addition, there may be other I/O systems connected to an Ethernet or token ring card as well.
- For each network there can be several multiplexers.
- There can be numerous field devices connected to each multiplexer.

The connection to your field device is established by allowing the user to browse through the networks, multiplexers and field devices. This browse function is part of the OPC Server. Figure 1 shows a sample browse screen that the user may see. In this example there are two networks. On the first network there are three multiplexers. In addition, the second multiplexer has two sub-panels. Since your device's manufacturer ID, device type and device revision is known you can ask the Server to filter the instruments that are browsed. This will ensure the device selected is your device.

Access to the device is associated with the tag string for the device. This is the communication path to the field device. Each network, multiplexer and the device's tag is separated by a dot (.). For example, the tag for the Moore Products 340S in Figure 1 would be

"Production Plant.UPPER TERRACE.PT943"

Your application does not need to decode this string. It merely uses this string to open the HART pass-through interface.

OPENING THE HART PASS THROUGH CONNECTION

Once the tag string has been obtained for your device the HART pass-through connection can be initialized. Like OPC, the pass-through interface uses OLE or, more specifically, Microsoft's Distributed Component Object Model (DCOM). This allows simple access from anywhere on the plant's corporate network. The pass-through interface has several methods or subroutine calls defined that allow device specific commands to be sent from your application to your field device. A few of the methods are shown in Table 1.

To open the pass-through connection call the "ConnectByTag" method using the tag string returned from the OPC Server browse function. This returns the handle for the connection. All subsequent calls to the pass-through mechanism are made using this handle.

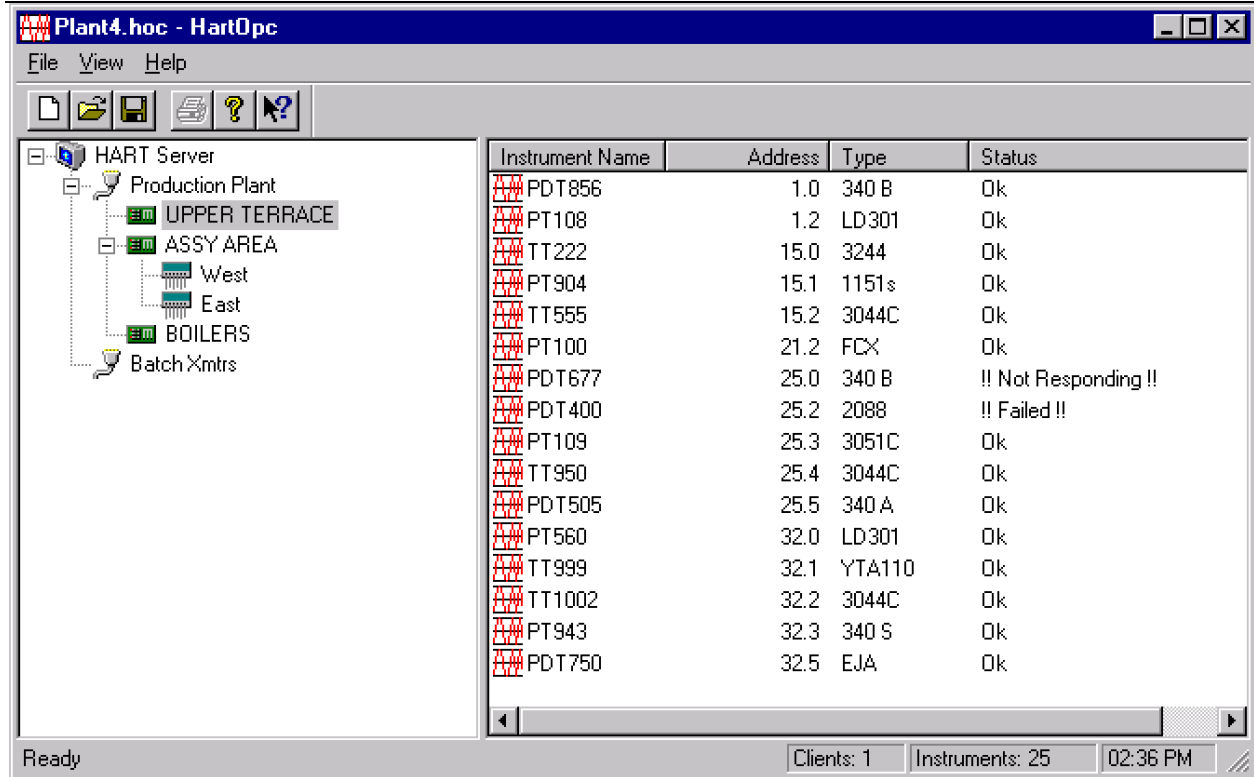


Figure 1 Browsing the Field Devices Connected to a HART OPC Server

Table 1 Sample HART Pass-Through Methods

Method	Parameters	Description
ConnectByTag	[in] BSTR szwAccess, [in] BSTR szwTag, [in] VARIANT_BOOL bExclusive [out, retval] long *plHandle	Uses the dot separated tag as the path to the field device. A connection is opened to that device and a handle for the connection returned.
Disconnect	[in] long lHandle	Disconnects the client application from the field device.
Send	[in] long lHandle, [in] SAFEARRAY psaCommand [out] SAFEARRAY *ppsaReply, [out, retval] long *lStatus)	Sends a command to the field device. The client provides a byte array containing the command number, byte count, and data. The data in the slave device reply and the status are returned.

SENDING COMMANDS

Sending commands require only the command number, byte count, and the data field. An array containing these bytes is passed to the "Send" method. The Server will route the command to your device while adding the delimiter, address, and check bytes to form a proper HART message. In other words, the client application does not need to track device addresses or calculate message check bytes. When the slave device answers, Send returns the command, Byte count and data fields to the client. Send is synchronous and does not return until it has the slave response.

Additional methods are provided that allow asynchronous message transmission.

The pass-through interface has a higher priority in the Server than routine OPC-related scanning of the field devices. The command passed to Send is placed at the front of the message queue for the multiplexer connected to your field device. This allows diagnostic and configuration applications to have the best access and throughput via the Server.

Before exiting, your application must disconnect from the server thus freeing system resources.

SUMMARY

There are many benefits to using the HART OPC Server:

- The interface between your configuration utility and the Server is simple.
- The HART OPC Server allows you to focus on the application and on configuring your device without being burdened by the Link Layer or multiplexer details.
- Since the Server uses Microsoft DCOM technology, your configuration utility does not even need to execute on the same PC as the Server. The utility only needs to execute on the same PC network as the Server.
- Serial ports and communication resources are shared. One application does not monopolize Server resources.
- The Server provides a constant interface no matter the intermediate multiplexers or I/O systems.
- Wide spread use of the Server will allow users to access more the power of the HART Protocol and further expand the market for HART compatible products.

Perhaps most importantly, using the HART OPC Server is a low cost solution for developing a MS-Windows based configuration utility.