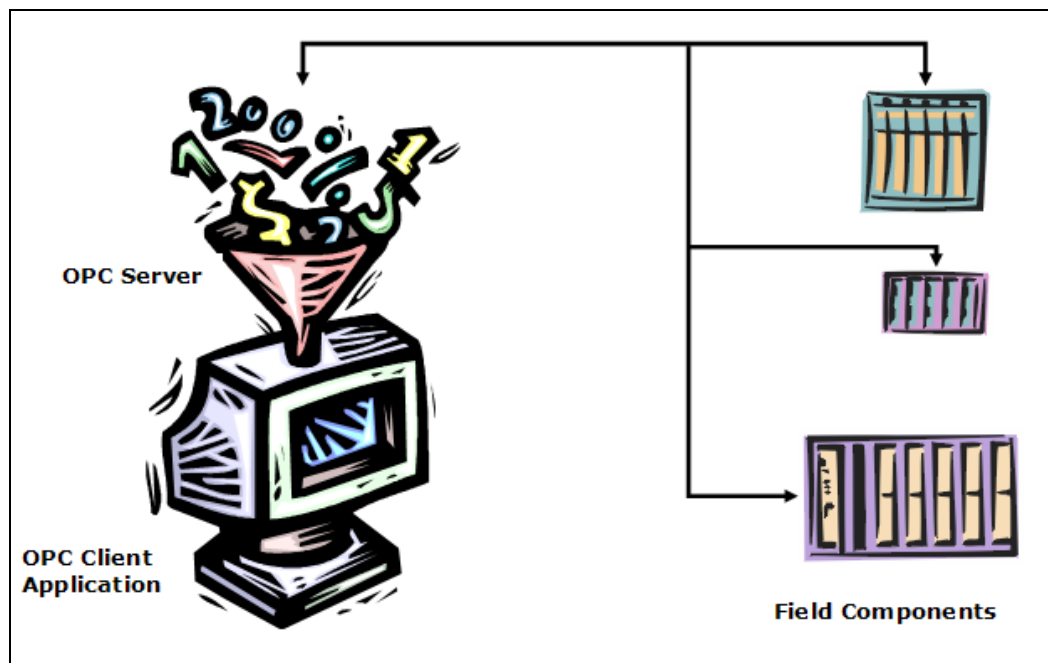


### KB2010-07: OPC SERVER TUTORIAL

The OPC server is the “hidden” part of an OPC-based system. It sits behind the scenes, where it passes data between your PLCs and the operator interface you see on the screen. Although its operation is critical to the system, it is typically the least understood component. In this introduction to OPC servers, we’ll take a look at this key piece of software, and answer common questions to help you understand what an OPC server does and why it is important to you.

For detailed information on how to configure and use Cyberlogic’s OPC servers, refer to their help files.



*Basic OPC-based system*

### Why do I need an OPC server?

A basic OPC-based system consists of three major components:

The *field components*, such as PLCs, instruments or other intelligent devices, that provide information you need to use.

The *OPC client* applications. Typically, these are HMI or SCADA applications that the user interacts with to view, save or manipulate the data from the field components.

The *OPC server*. This is a software application that handles communications, passing the data between the field devices and the client applications.

The purpose of the OPC server is to obtain data from the field devices and present it, in a standard way, to the OPC client applications. This relieves the client applications of having to deal with the myriad of devices, networks, protocols, formats and so on that exist among the various control device vendors. The client software need only concern itself with the graphics, logic, storage and other operations that it provides to the user.

In short, the OPC server acquires the data, while the OPC client manipulates and displays the data. Critically important are the OPC specifications, which describe how OPC clients and OPC servers exchange data. Compliance with the OPC specifications means that any OPC server will work with any OPC client, even if they are from different suppliers.

## **So does this mean that all OPC servers are the same?**

Most definitely not! The specifications ensure that all compliant OPC servers will present the data in the same way, but there is nothing in the specifications about how the OPC server obtains the data from the field devices.

OPC servers may vary dramatically in how rapidly they update the data, how efficiently they use the networks, how they handle communication errors and failures, what kinds of preprocessing they can do, their troubleshooting aids, configuration tools, and many other kinds of features. The most obvious difference between OPC servers is in the kinds of networks, devices and interface cards they support.

In choosing an OPC server, you must first select one that will handle the devices, cards and networks your system uses. Beyond that, you should evaluate the performance, features and capabilities of the different choices. Some of the features that are not part of the specifications may be critical to the success of your project.

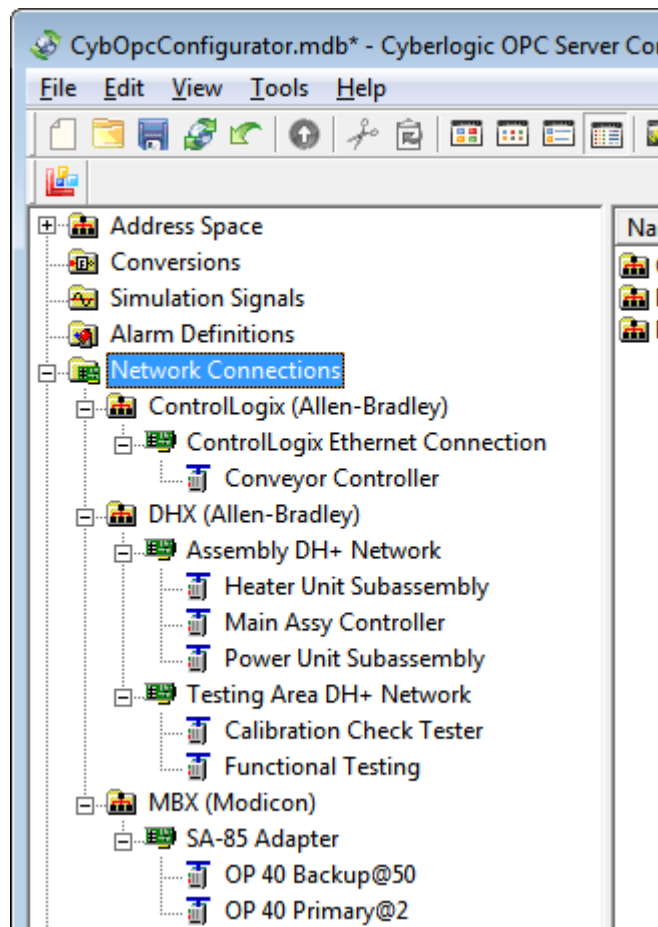
## WHAT DO I HAVE TO CONFIGURE?

Since some of the features of the OPC server are optional, you need not configure them if you do not want to use them. For most OPC servers, you must configure two things: the network communications and the desired data items (also known as tags).

Let us now look at how this is done in the Cyberlogic OPC servers.

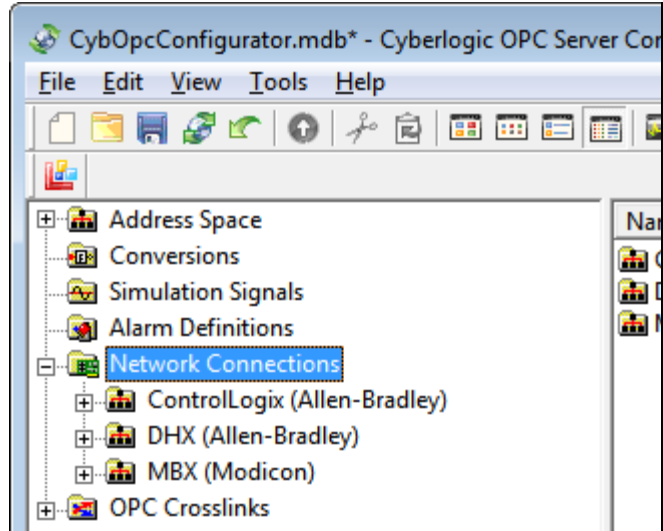
### Configuring the networks

The network configuration is done through the *Network Connections* tree, which you can see in the figure below.



*The Network Connections tree: This OPC server communicates to eight PLCs on four separate networks using three driver agents.*

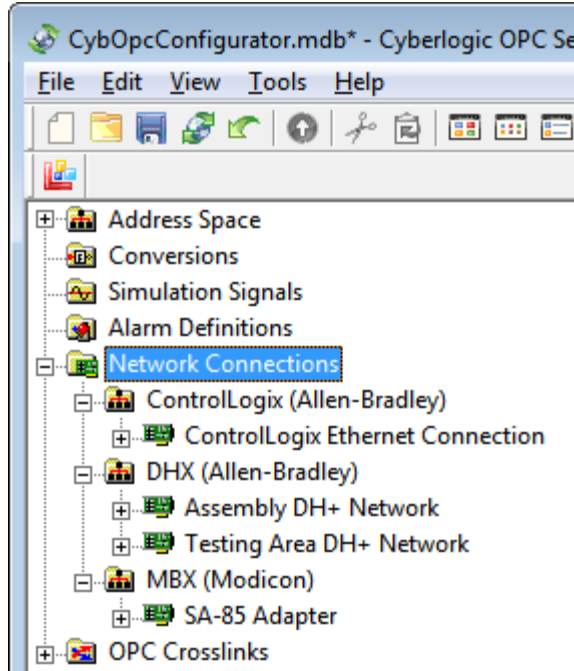
This configuration tells the OPC server what networks and field components are in your facility and how it connects to them. The Cyberlogic Configuration Editor will do most of the network configuration for you, automatically. However, it is a good idea for you to be familiar with the structure of the tree and what each of its parts represents.



*The network connections folders*

Under the Network Connections tree, there are three levels of branches. The first level, as shown above, identifies the *driver agents* used in the system. How many of these agents are available to you depends on which Cyberlogic OPC server products are installed on your system. In this example, we show three driver agents: the ControlLogix driver agent for Allen-Bradley ControlLogix networks and devices, the DHX driver agent for all other A-B networks and devices, and the MBX driver agent for all Modicon networks and devices.

Each of these branches is a folder that contains the connections associated with that particular driver agent. You need not concern yourself about how to manage these folders, even if you choose to configure your network manually. As you add network connections to your configuration, the Configuration Editor will create the necessary folders automatically, and will place the network connections in the proper folder.



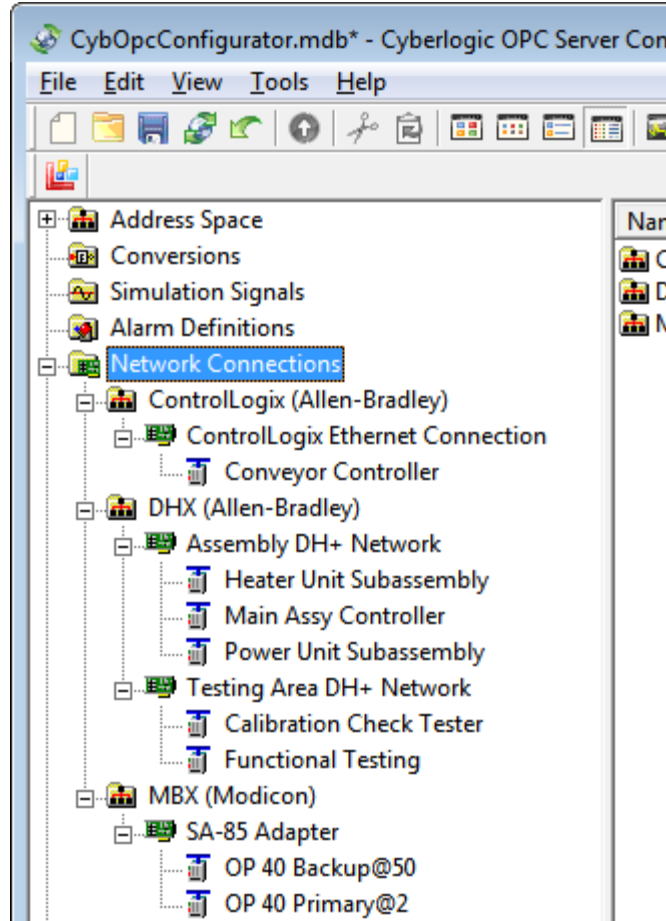
*The network connections within each folder*

The second level of branches is shown in this figure. This level shows the actual *network connections* within each network connection folder.

A network connection represents a physical device, adapter card or port through which the OPC server connects to a network. Examples include a PCI-85 Modbus Plus adapter, an Ethernet card, and an RS-232 serial port. Each network connection requires a device driver to be installed in the OPC server's computer. All Cyberlogic OPC Server Suites include a complete set of device drivers.

You may have more than one network connection within a folder. In the example shown, there are two Data Highway Plus network connections within the DHX (Allen-Bradley) folder. It is not required that all of the network connections within a folder be of the same type. You could, for example, have any combination you wish of Modbus, Modbus Plus and Ethernet network connections within the MBX (Modicon) folder. Finally, Cyberlogic's OPC server has no limit on the number of network connections you may configure. You are limited only by your hardware's physical capacity for expansion cards and ports.

Once you have created a network connection, you may name it however you wish. You could name it after the adapter card it uses, a description of the network to which it connects, or anything else that makes sense to you.



*The Network Connections tree fully expanded to show the network nodes*

The third and lowest branch on the Network Connections tree contains the *network nodes*, as shown in this figure.

The network nodes represent the physical devices on each network that contain the data you wish to access through the OPC server. Typically, these are PLCs, but they may also be other types of intelligent devices. Each network may have a mixture of device types as network nodes. A typical Data Highway Plus network might serve a combination of PLC-2, PLC-3 and SLC-500 controllers. The number and type of nodes on a network is not limited by the OPC server, but only by the capacity of the network. Cyberlogic's OPC server can handle any combination that the network will allow you to set up.

As with the network connections, you may name the network nodes any way you wish. This allows you to assign names that will help you and other users to make sense of which node is which on the network.

## **How do I configure the Network Connections tree?**

Like all of the other devices in your system, the network devices require drivers to operate. Before you can configure the networks, you must be sure that these network device drivers are installed and configured. Cyberlogic's OPC Server Suites include all of the drivers you need, so that they can be installed as part of the complete software

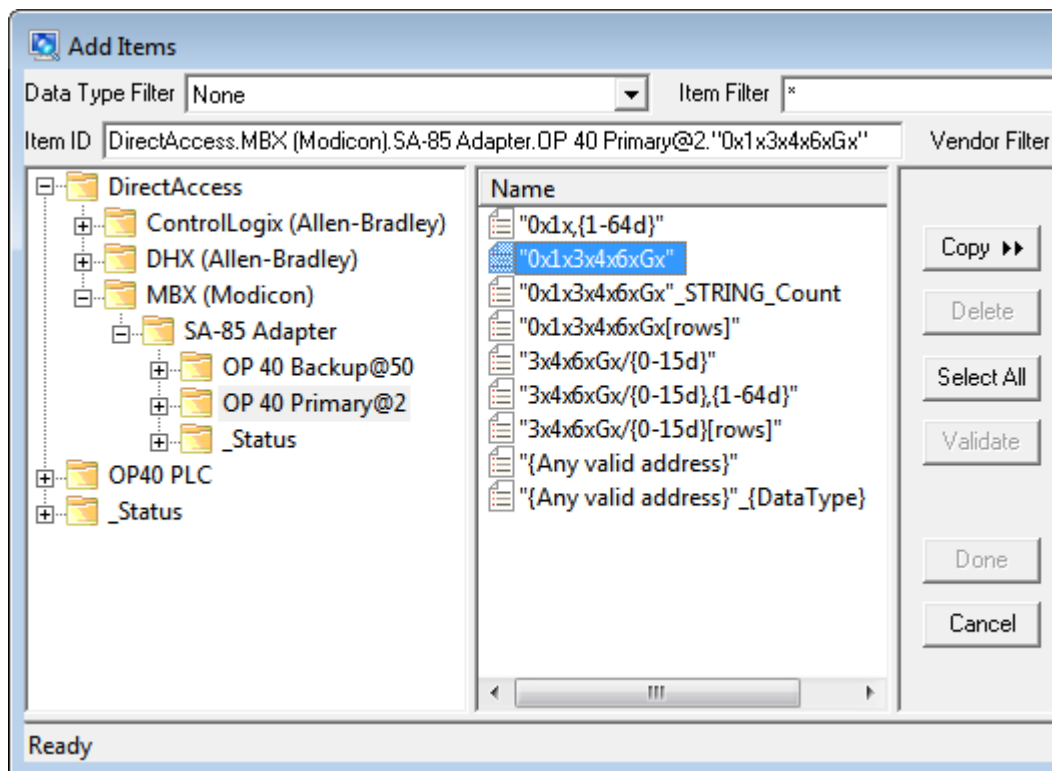
package we provide. Most newer network devices are Plug-and-Play compatible, and Cyberlogic's OPC server will configure them automatically. If you are using Ethernet, a serial network, or an older, non-Plug-and-Play device, you must configure the device manually, as described in the driver documentation. You will then be ready to configure the network connections and nodes.

The simplest way to do this is to use the auto configuration capability of the Cyberlogic OPC Server. Once the OPC server computer is connected to all of the networks, you need only right-click on the Network Connections root branch and select *Auto Config*. The editor will identify all of the network connections in your system, then scan each of the networks to identify the network nodes that are present.

The OPC server will fully configure all of the MBX and DHX connections and nodes, so all you need do is to give them descriptive names. For the ControlLogix case, the OPC server will identify the network connections and detect the nodes. Limitations in the ControlLogix devices prevent the OPC server from fully configuring them, so you must manually complete the configuration. The Cyberlogic OPC server documentation provides detailed information on how to do this.

## OK, the server has the data. How do I get it to the client?

If all you want to do is to access the data, and you do not need any of the advanced features of the Cyberlogic OPC Server, the quickest way to do this is by using *DirectAccess*. This is also the easiest way, because no more configuration is required.



*Obtaining data using Cyberlogic's Direct Access feature*

The figure above shows how the DirectAccess feature will appear during the configuration of a typical OPC client.

As you add an item to the client configuration, Cyberlogic's OPC server will include a branch called DirectAccess among the selections available to you. Within this branch is a tree that replicates the Network Connections tree, showing all of its folders, network connections and network nodes.

To access a value, simply navigate through the tree to find the PLC or other data source you want to access. The OPC server will provide you with a list of "hints" showing the structure of the register address you must specify. You can then simply type in the address of the specific input, coil, register or other data value, and it will be available to the client.

In the example shown, the address hint in the Item ID field is:

*DirectAccess.MBX (Modicon).SA-85 Adapter.OP40 Primary@2."0x1x3x4x6xGx"*

You must replace the last field in this hint with the actual address. The *0x1x3x4x6xGx* hint tells you the type of Modicon addresses that this Item ID will accept. Suppose you want to access the data in register 400001 of this controller. You would edit the Item ID to read:

*DirectAccess.MBX (Modicon).SA-85 Adapter.OP40 Primary@2.400001*

## **Why should I configure the Address Space tree?**

DirectAccess is useful and convenient for very simple set-ups, but it does not allow you to use several of the important features that Cyberlogic includes in the OPC Server Suites. These include:

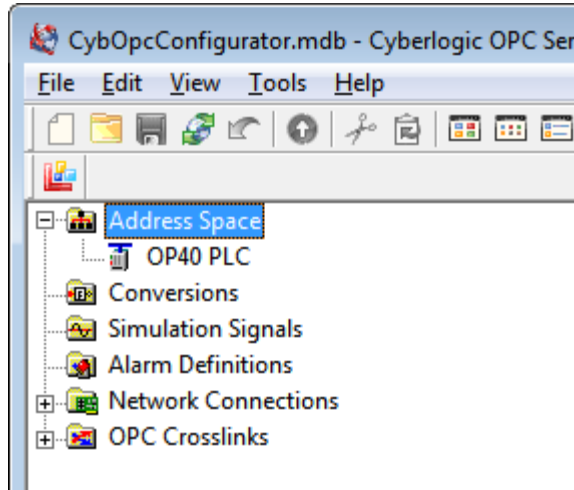
- Logical grouping of data items
- Unsolicited updates
- Write protection
- Redundant network support
- Redundant data source support
- Data type override
- Bit ordering
- Unit conversion with range limiting
- Simulation

To use these and other features, you must configure an Address Space tree containing the devices and data items your client will use. The Address Space tree defines how the server will organize, group and name the information that it will present to the clients.



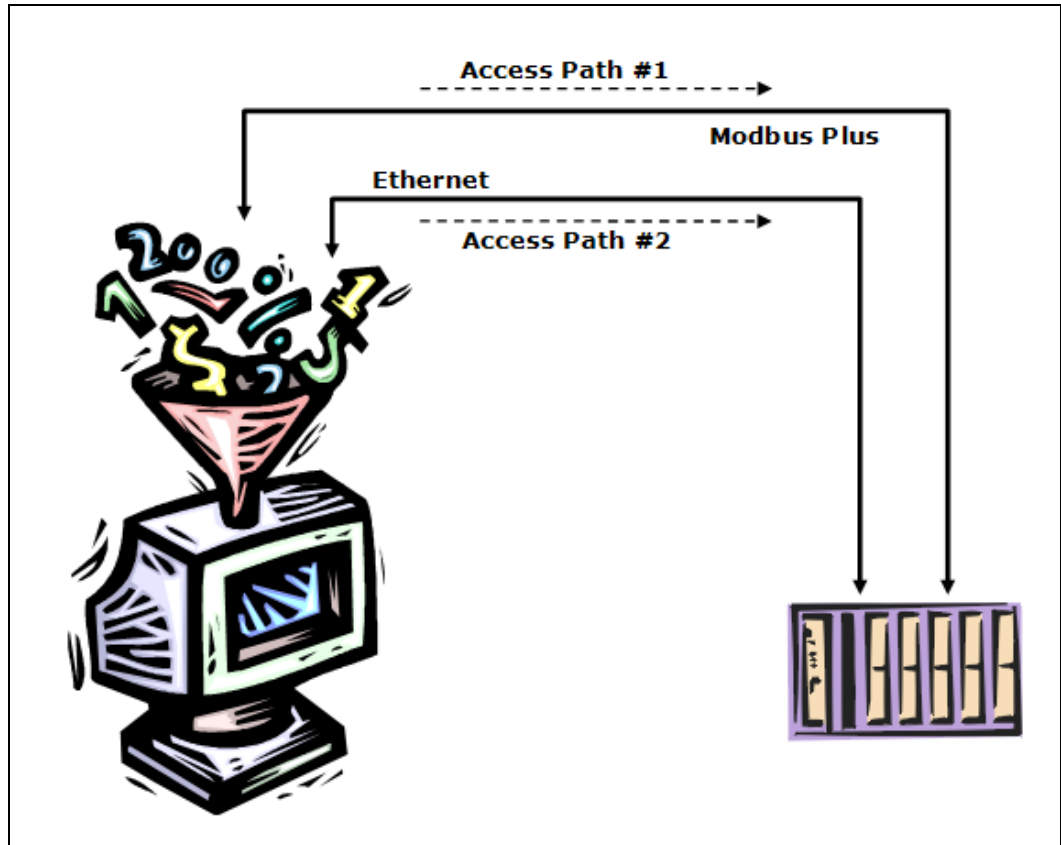
## Configuring devices in the Address Space tree

The first required step in the Address Space tree configuration is to create one or more *devices*. A device specifies one or more field components that are the source of the data you want to access.



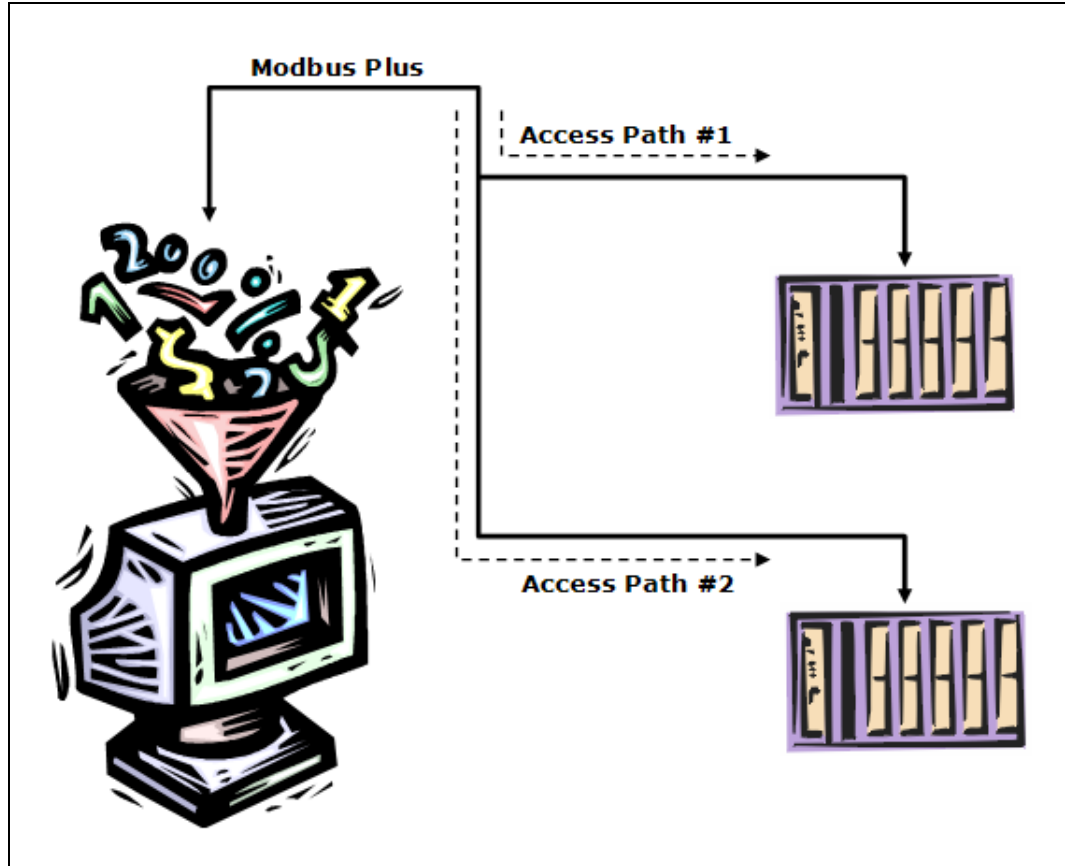
*The Address Space tree showing one device*

To associate a device with a field component, you simply identify the network connection and network node of the desired field component. This combination of network connection and network node is called an *access path*.



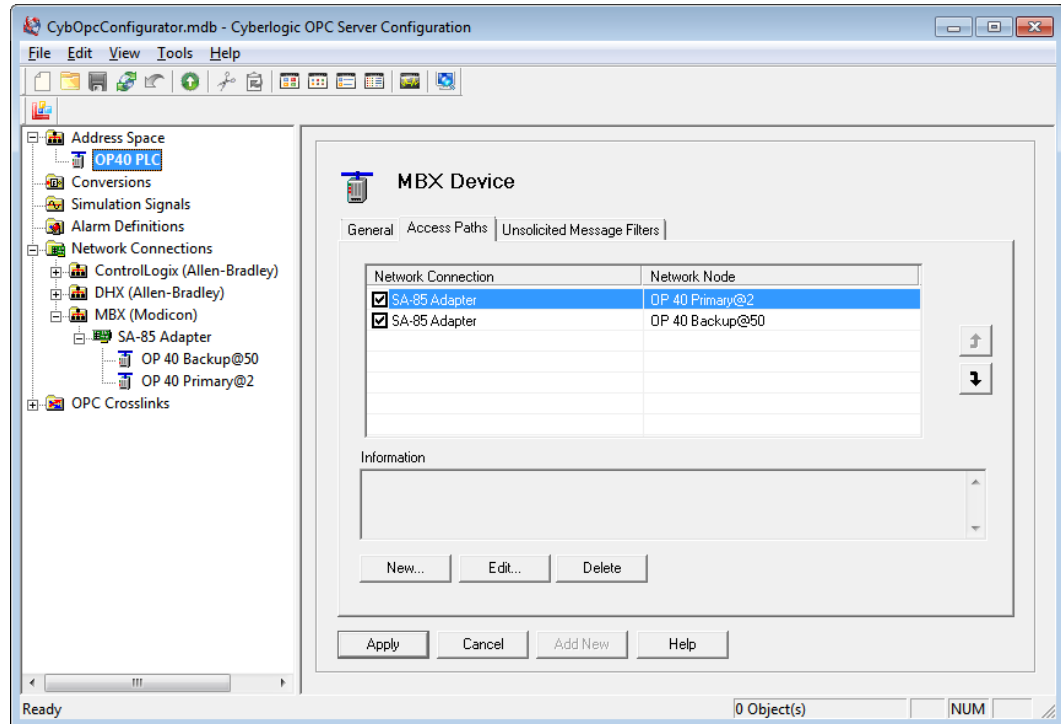
*Redundant networks forming two access paths to a PLC*

You may specify an unlimited number of access paths for a device. In the figure above, there are two networks—and therefore two network connections—that the OPC server can use to communicate to the PLC. You can specify either or both of these access paths when you create the device. If you specify both access paths, you create redundant communication capability to the PLC. At run time, if the primary access path fails, the OPC server will continue to receive and send data over the secondary access path.



*Access paths to a primary and backup PLC*

You can also specify, for a single device, access paths that go to different field components. This figure shows a pair of access paths that go to two different PLCs. Even though they go to different physical components, you can use both paths for a single Address Space tree device. This configuration creates a redundant PLC setup. You might do this, for example, if one PLC is a primary controller and the other is its backup. If the access path to the primary PLC fails, the OPC server will continue to receive data from, and write data to, the backup PLC over the secondary access path.



*Creating a device with primary and backup PLCs*

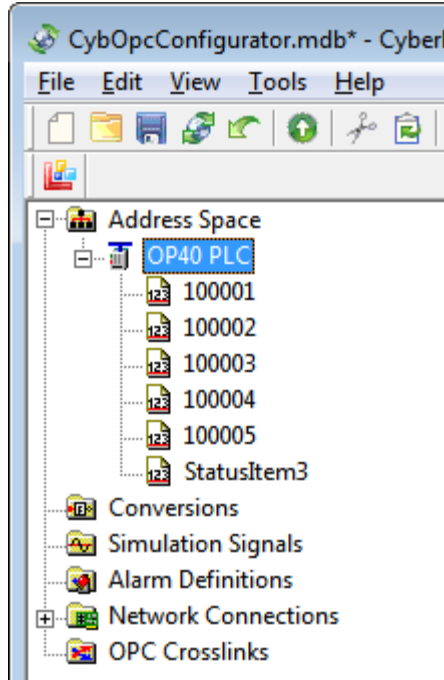
Here is how this type of configuration looks in the Address Space tree. In the Network Connections tree, we see that OP 40 has two controllers, a primary and a backup. These are both accessible through the SA-85 Adapter network connection. Because they are a primary/backup pair, we can use them to set up redundant access paths.

The device in the Address Space tree is called simply OP 40 PLC, and we set up two access paths, one to the primary controller and the second to the backup controller. The order in which we list the access paths is critical, because that determines the priority that the OPC server will use in its communications.

You can also set up redundant access paths to separate PLCs on separate networks. Cyberlogic's OPC Server software does not limit you in the number of PLCs or the number of networks you can use to set up these redundant access paths, nor does it limit the number of access paths you can configure. You are limited only by the capacity of your hardware.

## Configuring data items

After you create a device, you must configure *data items* within that device. A data item is an input, coil, register, array or other piece of data you want to access within a device.

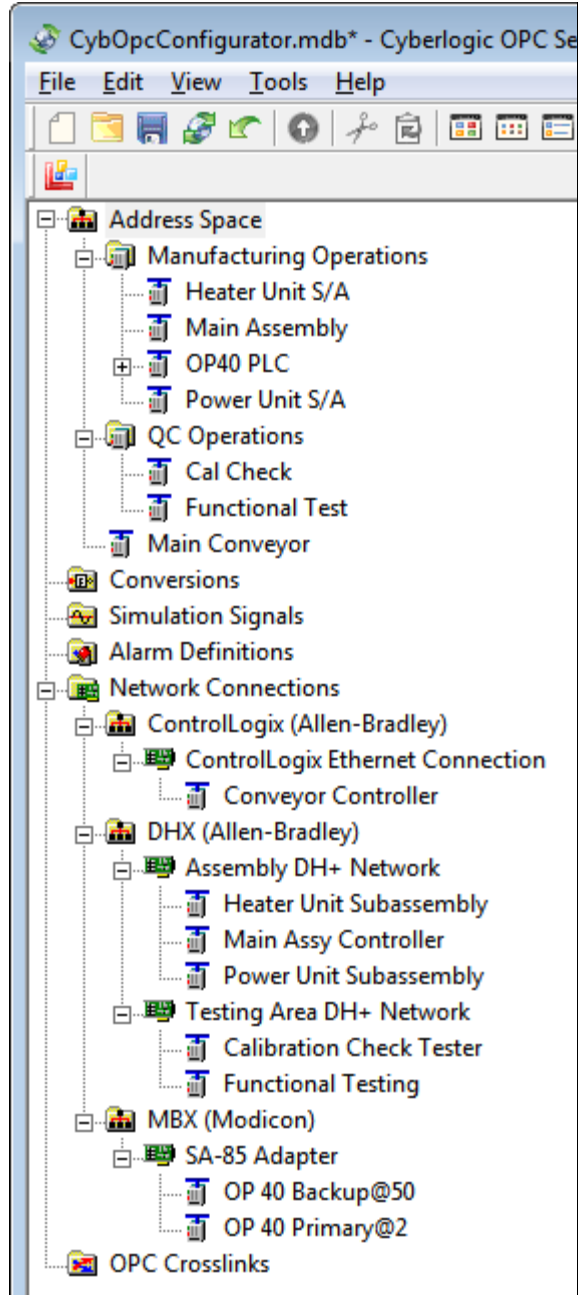


*Data items for the OP40 PLC device*

Notice that you may name the data items however you wish. In the example above, five inputs are simply named with the input number, as you would see them in the PLC. The last data item has a more user-friendly name. When you name the data items, keep in mind that these are the names the user will see when configuring the OPC client application. You want to choose names that will be clear and helpful to that person.

## Organizing the Address Space tree

Although it is not necessary to do so, most users will want to organize the Address Space tree in a way that groups together related data items. Cyberlogic's OPC Server allows you to create *device folders* to group devices, and *folders* to group data items.



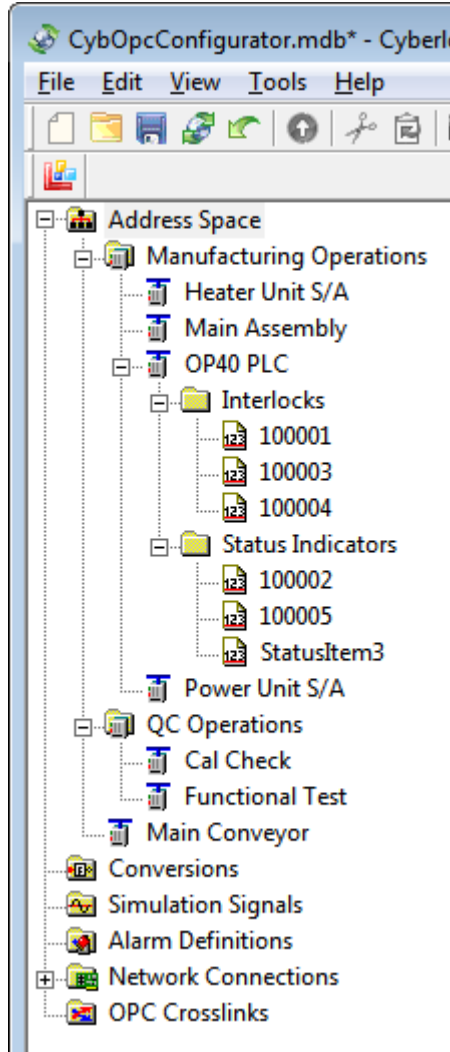
*Grouping devices using device folders*

In the example above, the user placed the devices that relate to manufacturing operations into one device folder, and those that relate to quality control operations into a second device folder. The conveyor relates to the entire plant, so it was left separate.

Notice that a device folder can contain devices that are of different families and are on different networks. Although not shown in this example, devices that relate to the same network can be placed in different device folders. In addition, you can nest device folders within other device folders, up to four levels deep. All of this grouping is fully independent of the type, location and organization of the physical components in the plant. This permits you to group the devices however you wish, in whatever way makes

sense for you. Of course, you can group them in a way that mimics the physical organization of the plant, if you choose.

Within each device, folders allow you to group data items in a similarly logical way. The figure below shows how this might be done.

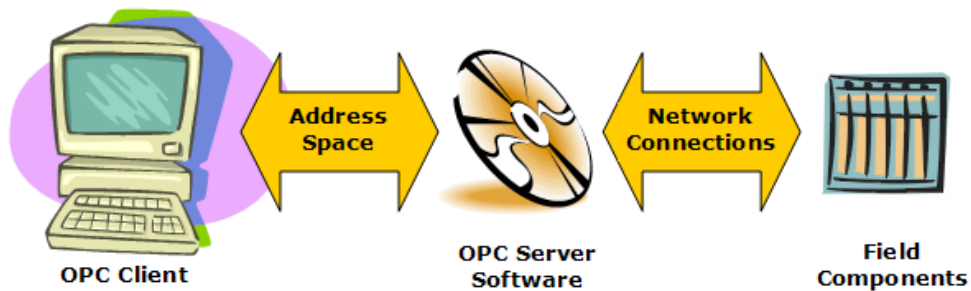


*Grouping data items using folders*

In this instance, the user has grouped the interlock inputs into one folder, and several status indicator data items into another. Once again, there is no restriction as to how the data items within a device are grouped. You may also place folders within other folders, up to four levels deep.

## AVOIDING CONFUSION

New users are sometimes confused about the difference between network connections and access paths, or devices and network nodes. They may also be unsure about the relationship and distinctions between the Network Connections tree and the Address Space tree.



To help keep this straight, remember that the OPC server provides the connection between the field components and the OPC clients. Its purpose is to present the data to the OPC clients in a standard way, regardless of the nature or organization of the equipment that is the source of the data. This means that the OPC server interfaces in two directions, and both of these must be configured for the OPC server to work properly.

On one side, the Network Connections tree describes the interfaces to the field components. The OPC server must use connections to physical networks (network connections) to talk to physical field components on those networks (network nodes).

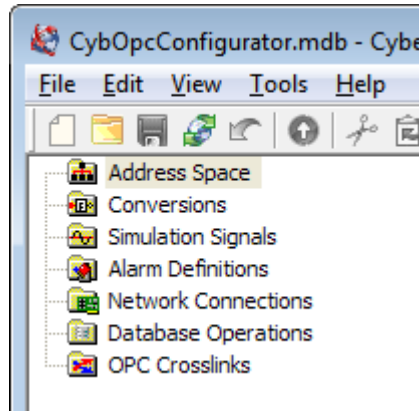
On the other side, the Address Space tree sets up the interface to the OPC client. The OPC server must present the information that the OPC client needs (data items) in a way that is meaningful to the OPC client. To do this, it must present the information in a standard manner that conforms to the OPC specifications.

The two sides come together by defining routes (access paths) that connect a data item through a network to a specific field component. A set of access paths that can pass information to one or more data items is called a device.



## WHAT ABOUT THE OTHER PARTS OF THE CONFIGURATION TREE?

There are four more branches in the configuration tree. These are optional items that are not needed for basic data access operations, but may be useful in your system. The software documentation contains details of these branches and how to use them, but here is a brief description of each.



*The configuration tree main branches*

*Conversions* allow you to define a linear or square root function that you can apply to a data item to convert its value to a different scale. You would use this, for example, to convert the voltage reading from a pressure transducer into an actual psi value. Conversions also allow you to specify a range of values, in engineering units, and clamp the value within that range.

*Simulation Signals* are useful in testing and debugging your system. You can create many different functions, such as ramps, sine waves and square waves, and use these signals in place of the actual values obtained for any data item.

*Alarm Definitions* allow you to specify the conditions under which you want to declare an alarm and the message that is associated with that alarm. You can then apply an alarm definition to a data item, to generate an alert under the specified circumstances. You would define alarms only if you use an OPC client application that supports the OPC Alarms & Events specification.

*Database Operations* are available only in Cyberlogic's OPC Enterprise Suites and OPC Datacenter Suites. This feature allows you to log OPC data in popular databases or run stored procedures in these databases. It includes memory and disk caching to prevent data loss, and has powerful enabling and triggering capabilities. Supported databases include MS SQL Server, Oracle, MySQL and MS Access

*OPC Crosslinks* are a feature available only in Cyberlogic's OPC Enterprise Suites and OPC Crosslink Suites. Crosslinks allow you to read data from any OPC data access server or PLC and write the value to any other OPC data access server or PLC. This allows you to create data bridges between any combination of OPC DA servers and PLCs, even if they are of different brands. For example, you can pass data from a Modicon Quantum controller to an Allen-Bradley SLC-500.

## WHERE CAN I GET MORE INFORMATION?

You can get detailed information on how to install, configure and use Cyberlogic's OPC servers by referring to the help files for the DHX and MBX OPC Server Suites, DHX and MBX OPC Premier Suites, and OPC Crosslink and Crosslink Premier Suites.

Cyberlogic's website, [www.cyberlogic.com](http://www.cyberlogic.com), has information on related products, news, software downloads and contact information.

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