SENSIA
Rockwell Automation + SLB

HCC2 Ethernet/IP:

Expand I/O and motor control with premapped subdevices

Save wiring time and engineering effort in setting up your HCC2 control system by selecting devices from HCC2's web-based library. Each subdevice is premapped to support inbound and outbound messaging. The HCC2's dual port Ethernet switch gives you the flexibility to use linear or redundant media topologies.

The bottom line

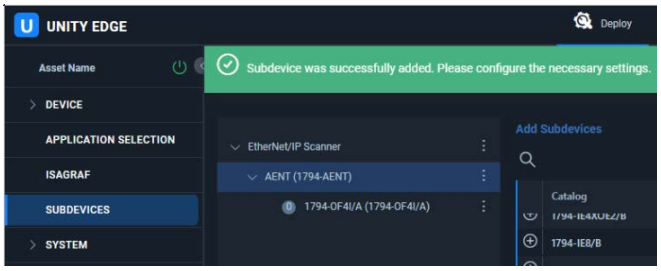
The HCC2 promises flexible and scalable I/O expansion by enabling control system architectures that distribute IO across distances up to 100m (328 ft) from the controller. You reap the benefits of:

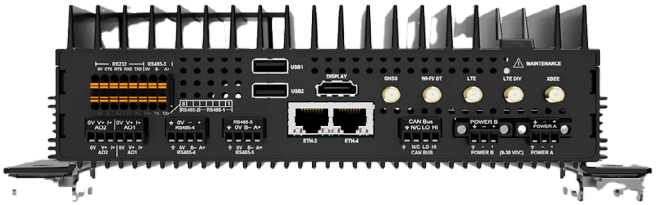
+ Reduced project design cost through reduced cable and junction box design
+ Reduced programming complexity by utilizing pre-mapped library of devices
+ Reduced field wiring costs compared to homerun cables with junction boxes
+ Reduced downtime due to the HCC2's automatic media fault recovery

For more info

See the Rockwell Automation Literature library for the following guides and more for help to design and implement Ethernet/IP and DLR networks for industrial automation systems.

+ Ethernet/IP Device Level Ring Application Note
+ Converged Plant Wide Ethernet (CPwE) Design and Implementation Guide





Ethernet/IP architecture

QRATE HCC2 Ethernet/IP protocol supports I/O expansion by using Rockwell Automation FLEX™ I/O, FLEX 5000® I/O, and PowerFlex® VFDs.

HCC2 functions as an Ethernet/IP Scanner that owns the remote Ethernet/IP Adapters. A single HCC2 can own the configuration and connection to multiple adapters. In turn, each adapter can connect multiple I/O modules.

When designing an HCC2 control system with Ethernet/IP, you must consider the total number of connections.

The HCC2 allows a maximum of 32 connections.

Each adapter and I/O module consumes at least one connection. You can add a maximum of eight I/O modules to a single FLEX™ I/O or FLEX 5000® I/O Adapter.

The HCC2 supports Ethernet/IP devices connected to linear, star, and ring architectures. Each architecture has specific design considerations.

Linear architecture

A Linear topology connects Eth-3 and Eth-4 ports to adapter modules. You can connect one adapter to each port. Connecting two adapters allows you to add up to 16 I/O modules.

Star architecture

When building a Star topology, use an Ethernet switch. You can use an unmanaged switch for a small network. However, we recommend a managed switch to support advanced network features.

Ring architecture

Use a Ring architecture for a redundant media topology. HCC2 supports DLR protocol on Eth-3 and Eth-4 only.

When implementing the HCC2 in a Ring topology, consider the following design points:

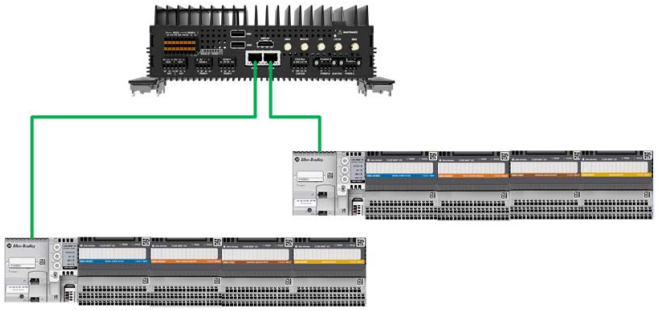
+ You cannot configure the HCC2 as a Ring supervisor.
+ You must configure at least one Ring supervisor for the ring to function. Therefore, to ensure proper functionality, set one of the Ethernet/IP devices on the network as the Ring supervisor.
+ You can use Rockwell Automation RSLinx software to configure an adapter as a DLR supervisor. The FLEX 5000® I/O pn. 5094-AENTR is one Ethernet/IP adapter that can perform the Ring supervisor function.
+ When designing a DLR ring, add devices that you can configure as Ring supervisors, such as
  - 1783 - ETAP/ETAPK/ETAP1F/ETAP1FK/ETAP2F/ETAP2FK
  - Stratix Switches 5200/5400/5700/5800
+ Configure a Ring supervisor before connecting the final Ethernet cable to complete the ring to prevent broadcast storms.

See the Ethernet/IP Device Level Ring Application Note for more DLR design and configuration information.

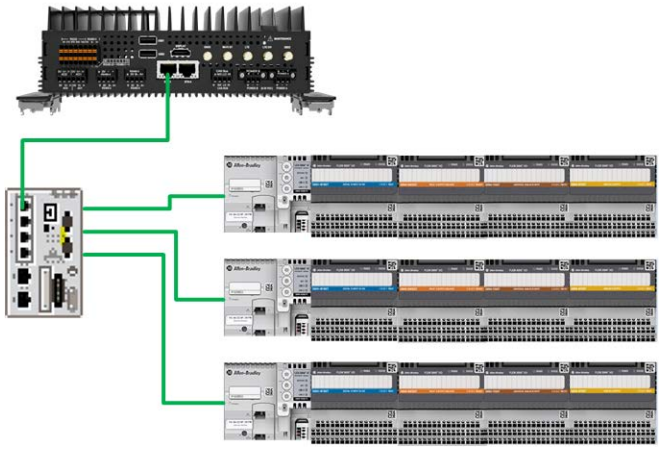
Configuring Unity Edge Subdevices

Use the Unity Edge configuration tool to set up adapters and I/O modules. Configure Unity Edge so that it matches the Ethernet/IP adapter and IO module layout of the system design.

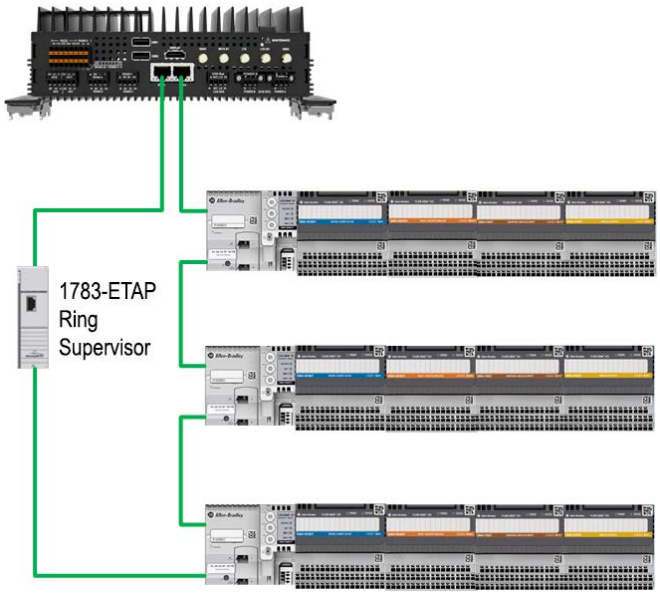
If you are familiar with configuring Ethernet/IP devices in Studio 5000 Logix Designer, you will find similarities with the Unity Edge configuration tool.



Linear architecture



Star architecture



Ring architecture

Configuring Unity Edge Subdevices

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See the table below for the pre-defined adapters and I/O modules that you can add as Unity Edge subdevices.

1794 FLEX I/O, 5094 FLEX 5000 I/O, 1426-M8E Power Monitor 5000, and various PowerFlex VFDs are pre-mapped to the HCC2 subdevices library. The 1794 and 5094 adapters are indicated as XT, but the non-XT version of the adapter also works.

	Catalog Number	Description
Adapters	1794-AENT	1794-AENT Ethernet Flex Adapter
	1794-AENTR	1794-AENTR FLEX Ethernet Flex Adapter
	5094-AEN2TRXT	5094XT Ethernet Adapter 16 Modules RJ45
	1426-M8E	PM5000
	PowerFlex 525 DataLinks	PowerFlex 525-EENET AC Drive with Configurable DataLinks
	PowerFlex 525-E	PowerFlex 525-E via 20-COMM-E
	PowerFlex 700H-E	PowerFlex 700H-E AC Drive via 20-COMM-E
	PowerFlex 700S	PowerFlex 700S 2P-400V Phase 2 AC Drive via 20-COMM-E
	PowerFlex 755 DataLinks	PowerFlex 755-ENETR AC Drive with Configurable DataLinks
	PowerFlex 755	PowerFlex 755-ENETR AC Drive
	PowerFlex 755T VHz DataLinks	PowerFlex 755T ControlMode VHz V1.0
	PowerFlex 755T DataLinks	PowerFlex 755T Drive with Configurable DataLinks V4.7
	PowerFlex 755TR DataLinks	PowerFlex 755TR Drive with Configurable DataLinks V2.3
IO Modules for Flex IO Adapters	1794-IA16/A	1794-16 Point 120V AC Input
	1794-IA8/A	1794-8 Point 120V AC Input
	1794-IB10XOB6/A	1794-10 Input/ 6 Output 24V DC, Sink/Source
	1794-IB16/A	1794-16 Point 24V DC Input, Sink
	1794-IB16D/A	1794-16 Point 24V DC Diagnostic Input Module
	1794-IB32/A	1794-32 Point 24V DC Input, Sink
	1794-IB8/A	1794-8 Point 24V DC Input, Sink
	1794-IE4XOE2/B	1794-4 Input/ 2 Output 24V DC Non-Isolated Analog
	1794-IE8/B	1794-8 Channel 24V DC Non-Isolated Voltage/Analog Current Input
	1794-IE8H/B	1794-8 Channel HART Analog Current Input
	1794-IF2XOF2I/A	1794-10 Input/ 6 Output 24V DC, Sink/Source
	1794-IF41/A	1794-4 Channel 24V DC Isolated Analog Input
	1794-IF8IH/A	1794-8 Channel HART Analog Current Isolated Input
	1794-IJ2/A	1794-2 Input Frequency Module
	1794-IRT8	1794-8 Channel 24V DC RTD/Thermocouple Analog Input
	1794-OA16/A	1794-16 Point 120V AC Output
	1794-OB16D/A	1794-16 Point 24V DC Diagnostic Output Module
	1794-OB16P/A	1794-16 Point 24V DC Protected Output, Source
	1794-OB8EP/A	1794-16 Point 24V DC Electronically Fused Protected Output, Source
	1794-OE4/B	1794-4 Channel 24V DC Non-Isolated Voltage/Analog Current Output
	1794-OF41/A	1794-4 Channel 24V DC Isolated Analog Output, Source
	1794-OF8IH/A	1794-8 Channel Isolated Analog HART Output
	1794-OW8/A	1794-8 Point Relay Output, Sink/Source
I/O Modules for FLEX 5000 Adapters	5094-IB16XT	Digital Input
	5094-IF8XT	Analog Input
	5094-OF8XT	Analog Output
	5094-OW8IXT	Relay Output

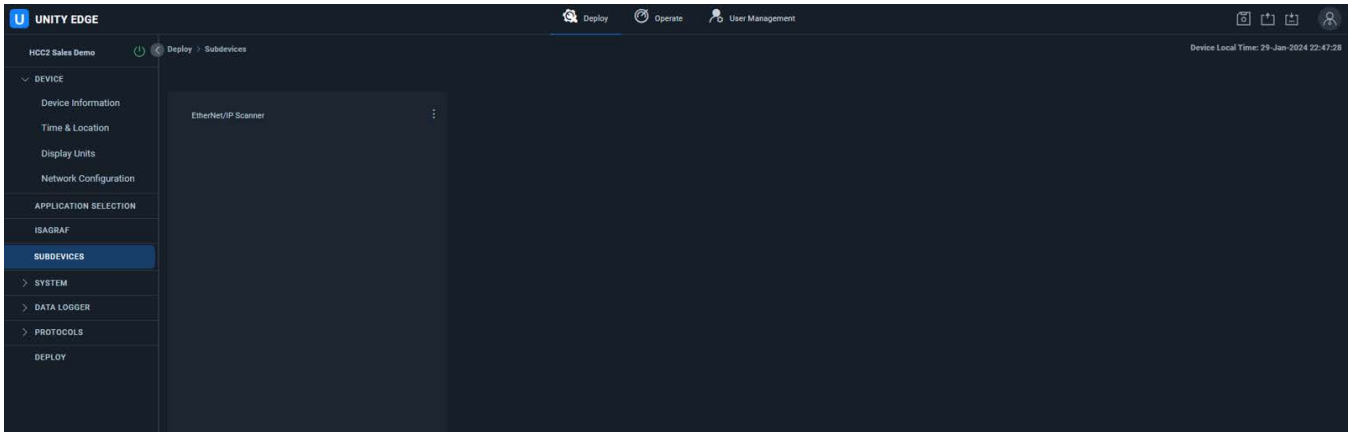
Procedure: Subdevice Configuration

To configure subdevices, connect to the HCC2 using an Ethernet, WiFi, LTE, or USB-C connection. Log into the Unity Edge interface with Administrator or Technician credentials. Other user accounts do not support subdevice configuration.

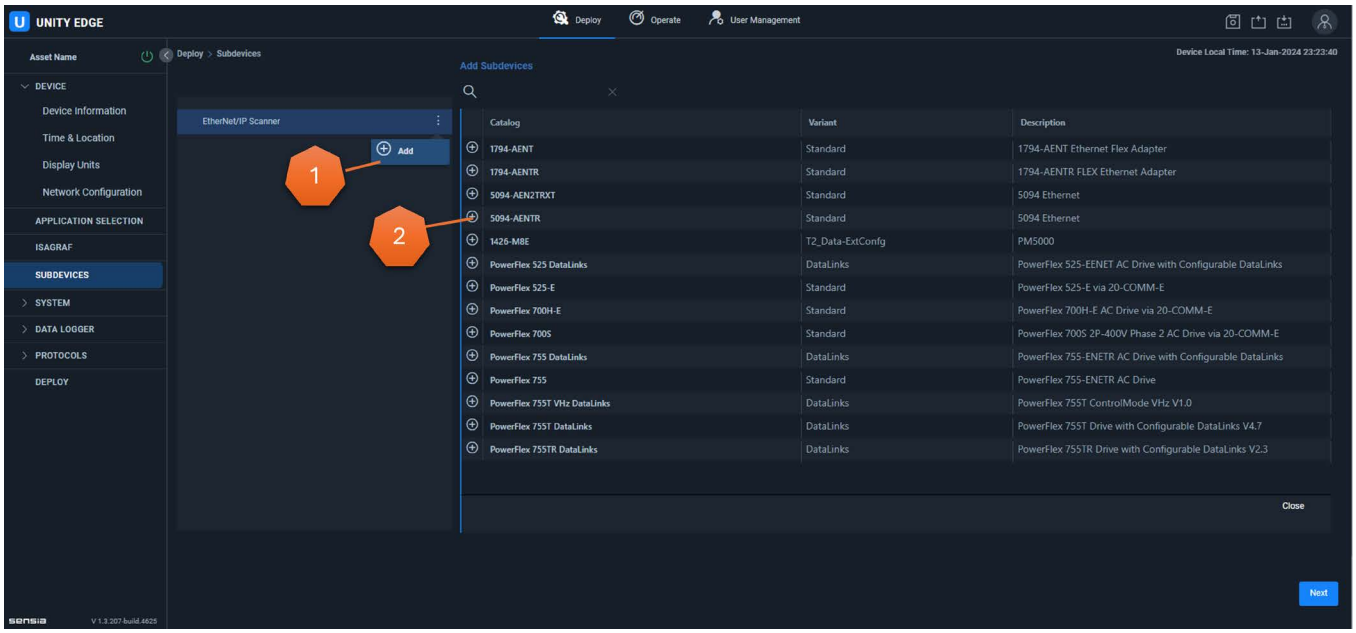
The following procedure shows how to add a Flex 5000 adapter with a 16 point input module.

Adding an Adapter

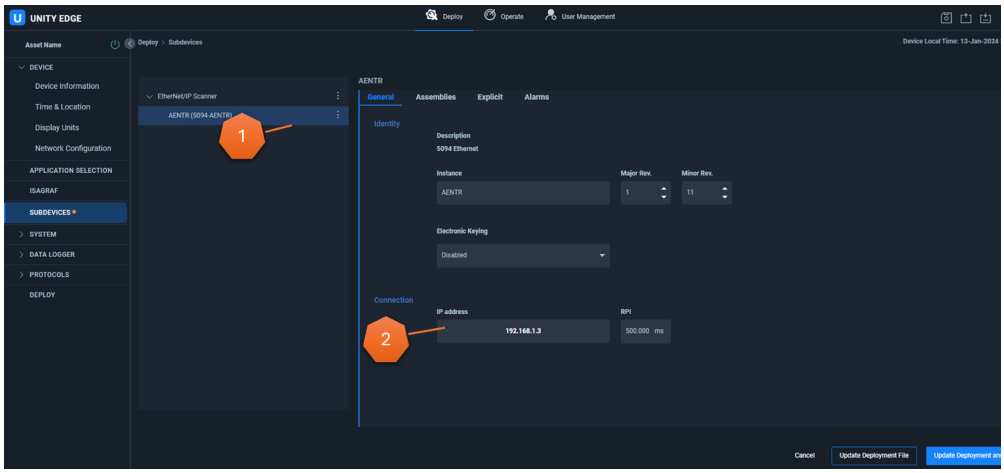
1. In the Unity Edge interface, select Deploy > Subdevices to access the Subdevices configuration screen.



2. Click Add in the left-hand column (1) and select the 5094-AENTRXT adapter in the Add Subdevices list on the right (2).



3. Click the AENTR adapter in the column on the left (1) and complete the IP address field on the right (2).



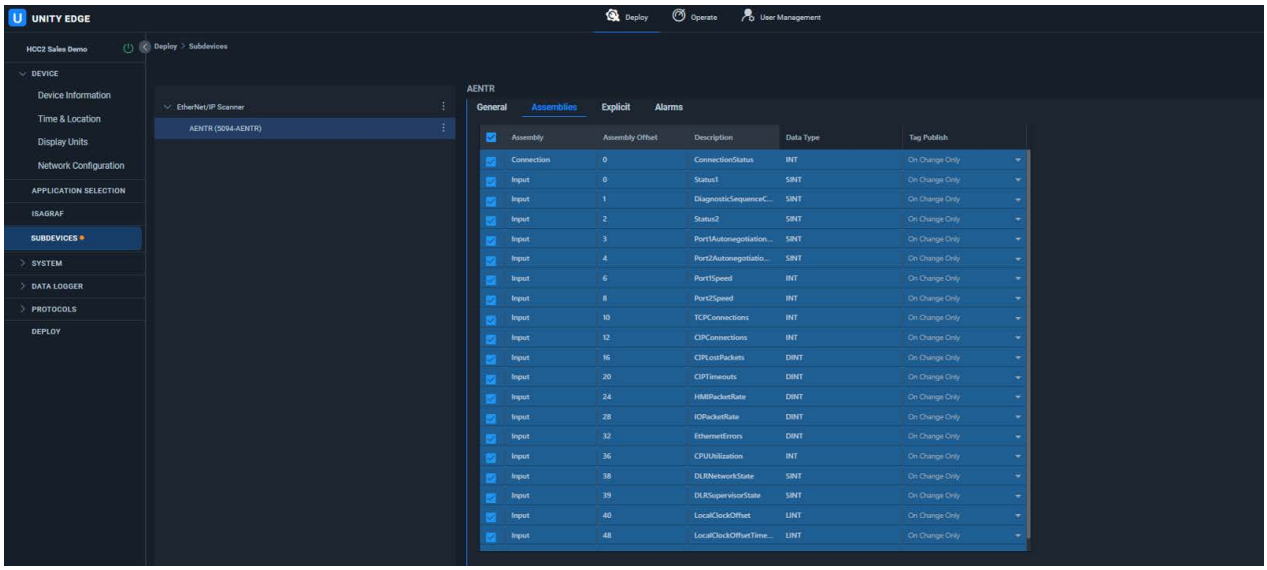
The IP address must be on the same subnet as the Eth-3 and Eth-4 ports and this subnet cannot be used by any other port. Each HCC2 port requires its own subnet, as shown below.

Port	Acceptable Subnet Configuration
Eth-1	192.168.20.5
Eth-2	192.168.2.41
Eth-3/Eth-4	192.168.1.33
WiFi	192.168.5.50

Port	Unacceptable Subnet Configuration
Eth-1	192.168.20.5
Eth-2	192.168.1.41
Eth-3/Eth-4	192.168.1.33
WiFi	192.168.5.50

subnet 192.168.1 cannot be shared by two or more ports

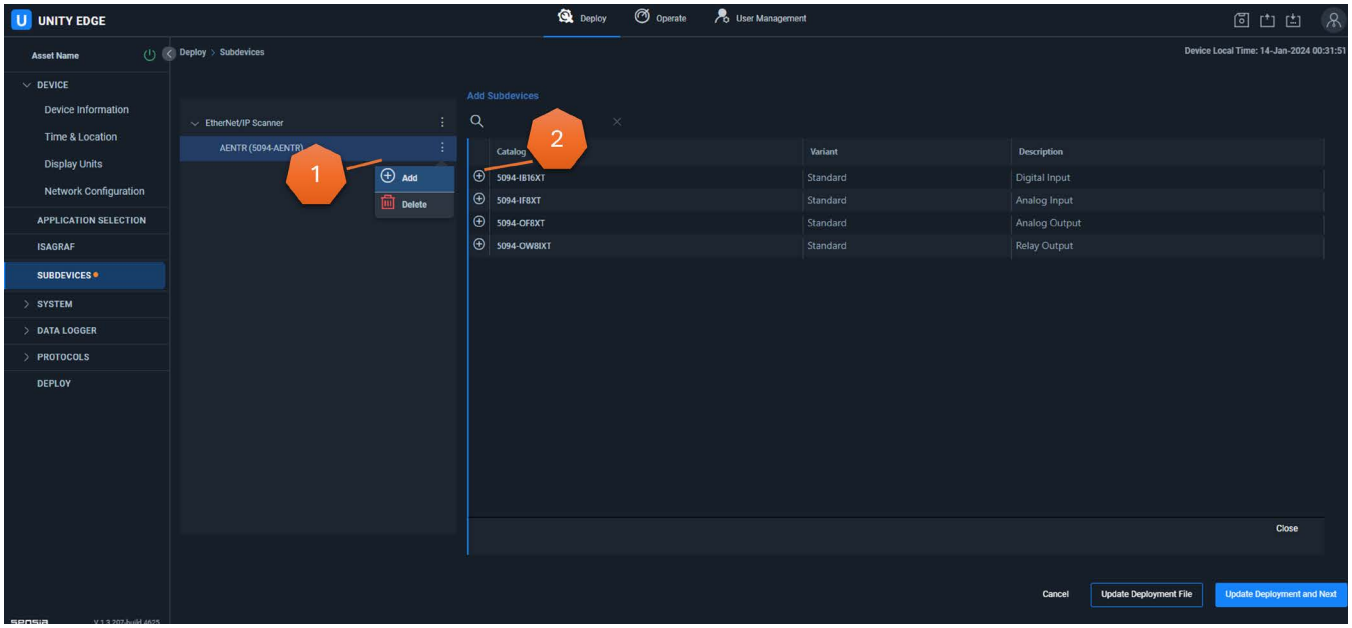
4. To make diagnostic tags available for selection, click the Assemblies tab and select the tags you want to be available for consumption in another app. Click the Assembly checkbox to select all tags in the list.



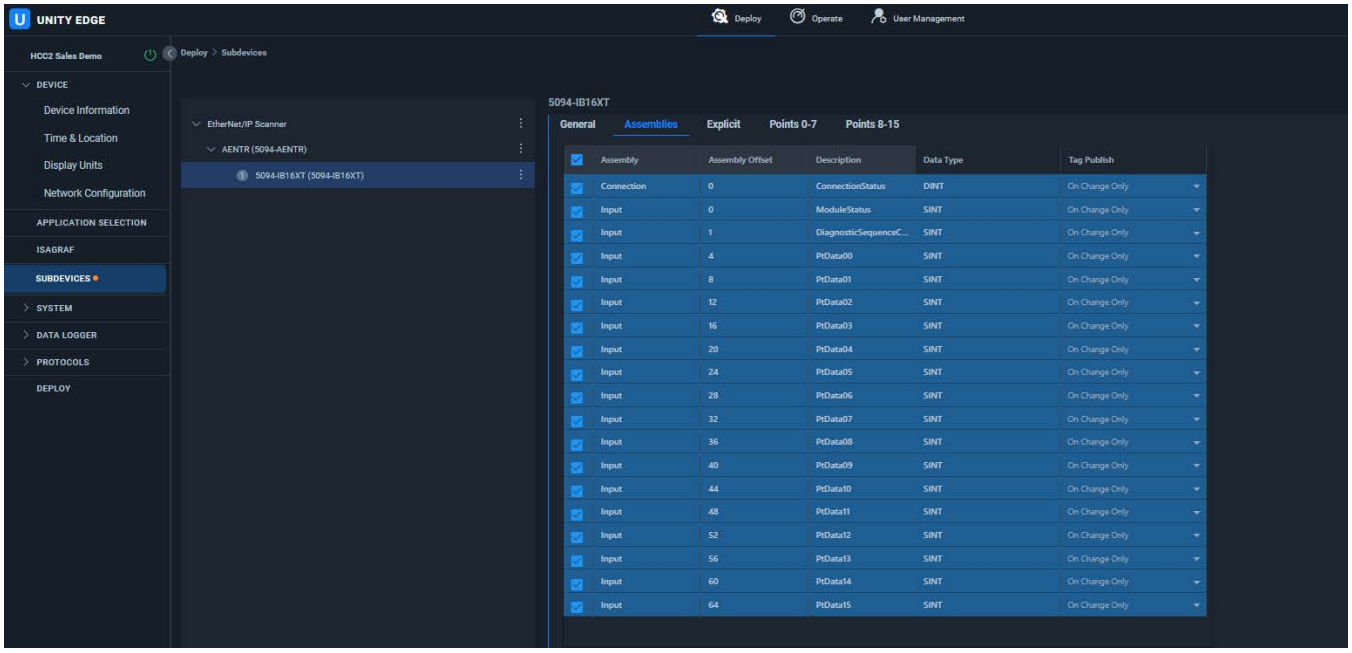
5. Leave the Explicit and Alarms tabs unchanged. They are not required to enable Ethernet communication.

Adding an I/O Module to the Adapter

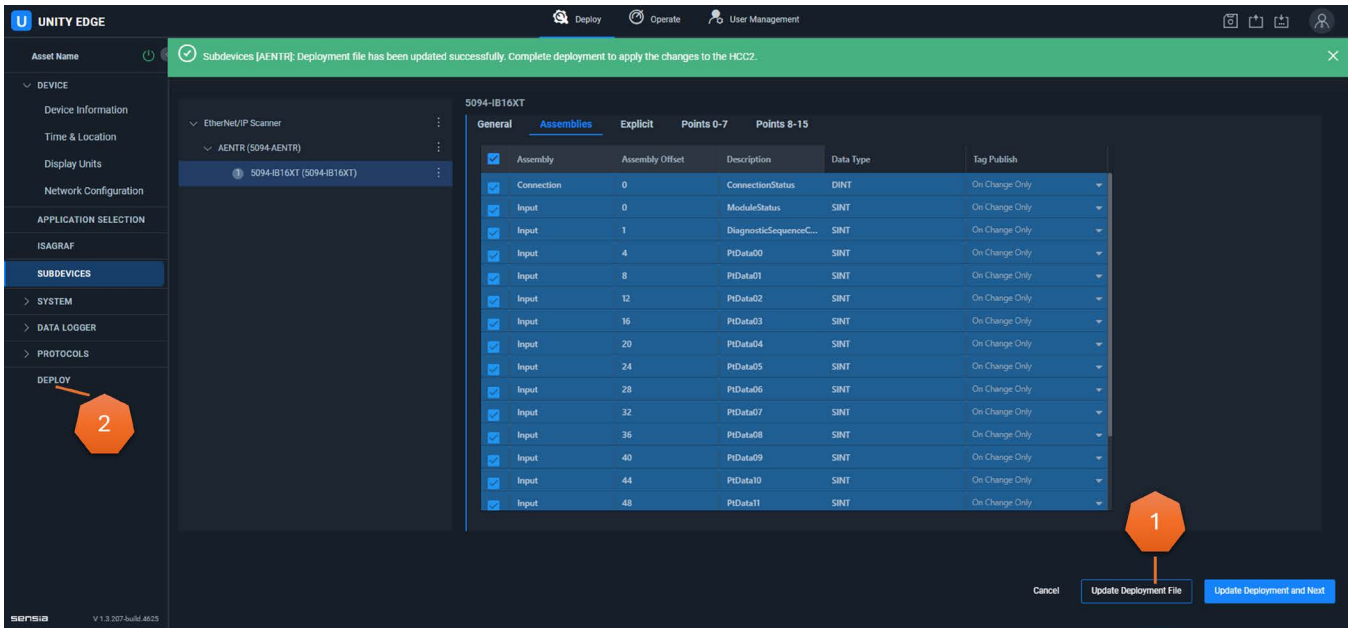
1. Click the adapter name in the left-hand column (1) and select the 16-point input module from the Catalog list on the right (2).



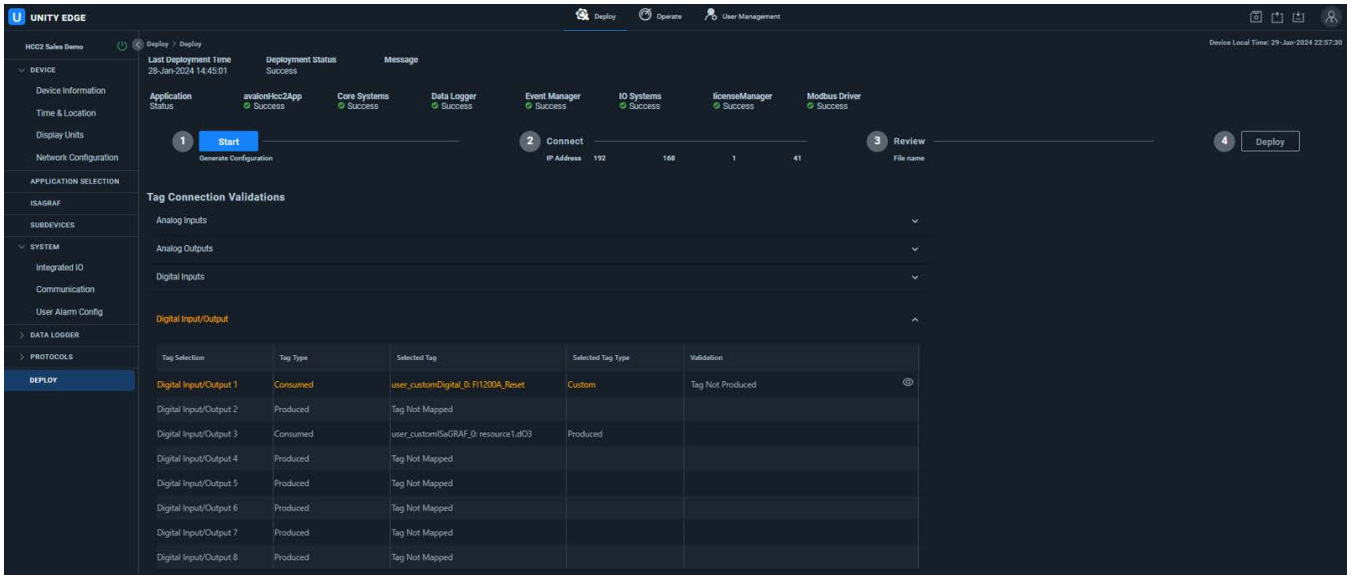
2. On the Assemblies tab, click the Assemblies checkbox to make the I/O points available for monitoring. The Subdevices configuration is then ready to be deployed.



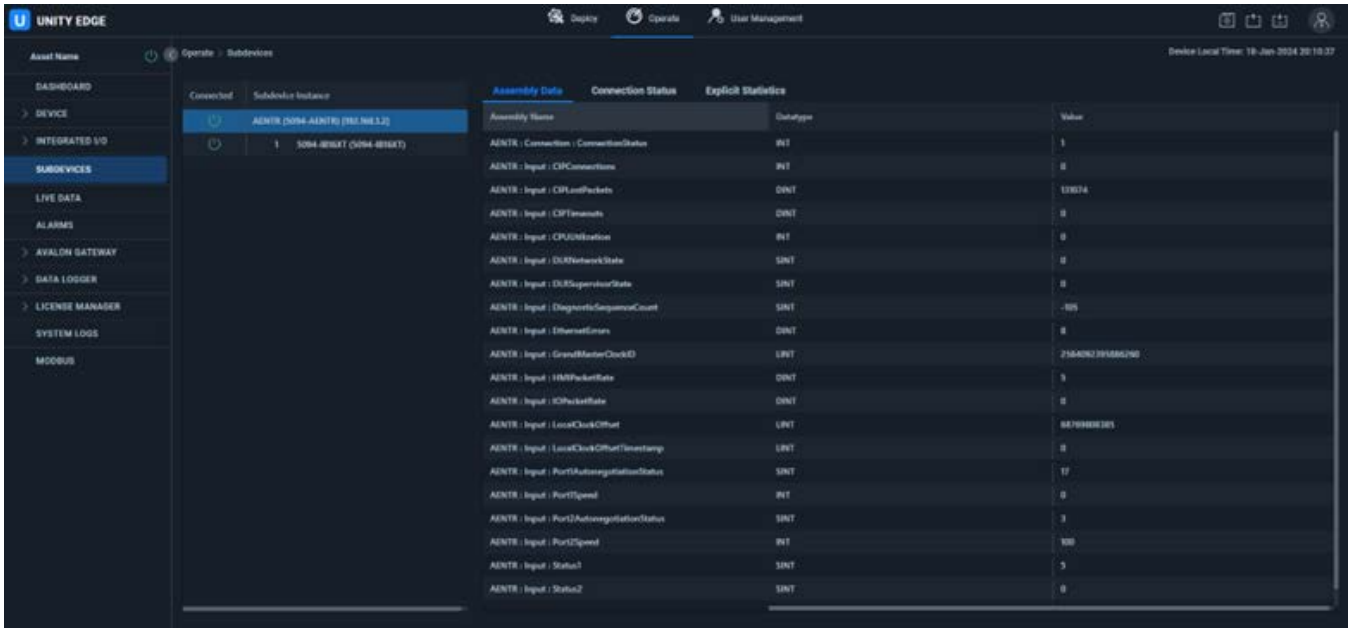
3. Click Update Deployment File (1) and then click Deploy in the navigation tree (2) to open the Deployment wizard.



4. Click Start and then click the Deploy button on the right to deploy the subdevice configuration to the HCC2 runtime environment.



5. When the deployment completes, click Operate > Subdevices to view the runtime subdevice data.
6. Select the adapter to view the live values in the Assembly Data tab.
7. Select the IB16XT module to view the I/O data and status in the Assembly Data tab.



Using Data from Subdevices

Subdevices allow I/O expansion and provide new diagnostics and data tags. Once a subdevices list is deployed, you decide what data to use. Unity Edge lets you view communication statistics and I/O data points. ISaGRAF allows programmers to utilize the I/O data from the subdevices for automation of equipment.

Unity Edge provides the Operate > Subdevices view to visualize the real time diagnostics and I/O data without using any external tools. Simply click on each item in the subdevices list to see the real time data (Assembly Data), and Communication Statistics. The Explicit Statistics tab is not implemented at this time.

Connection Status

The 5094-AENTR communication adapter has some diagnostics tags that can indicate a connection's status. In the image below, the ConnectionStatus (1) and the GrandMasterClockID (2) indicate the connection status of the device and can be mapped to other applications, or to ISaGRAF variables so a user can make decisions programmatically.

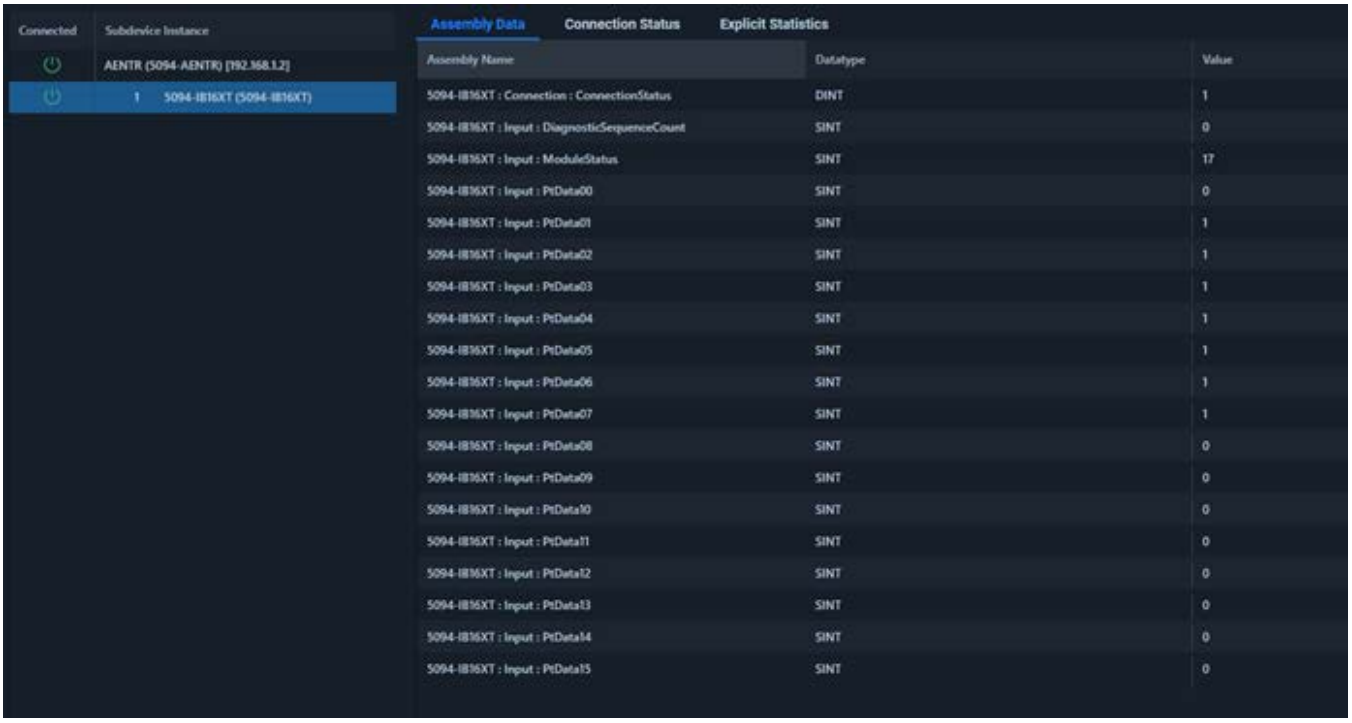
Other tags in the AENTR Assembly Data will allow you to see DLR status and port speed. Depending on the type of architecture (Linear, Star, DLR) you choose, you may want to use these tags in your logic as well.

Adapter connection statuses are not available for use programmatically, but they can be viewed in Unity Edge for troubleshooting purposes. Connection status is available for every adapter and I/O module supported.

The IB16XT module Assembly Data tab provides diagnostic and real time I/O data. The ConnectionStatus tag can be used to determine if the module is connected to the adapter and healthy.

I/O Data Presentation

Each module differs in the way I/O data is presented. Some use individual tags per point and some combine multiple points in one tag. For example, some 16 point digital input modules may store all 16 inputs in one INTEGER tag. The 5094-IB16XT module used in our example stores each digital input in a separate tag.



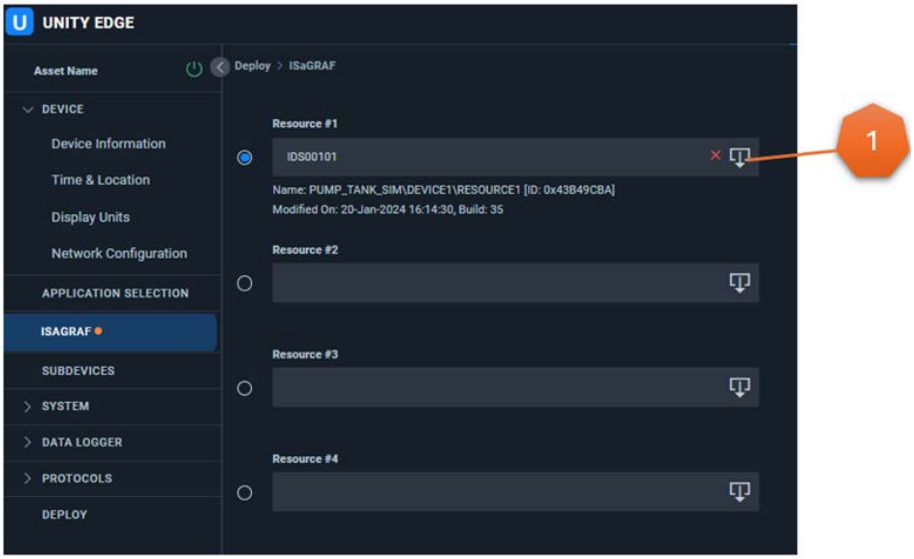
Procedure: Map Subdevice I/O and Data to ISaGRAF Variables

With Unity Edge, you can map subdevice I/O and diagnostics data to ISaGRAF variables for use in automation logic using the procedure below.

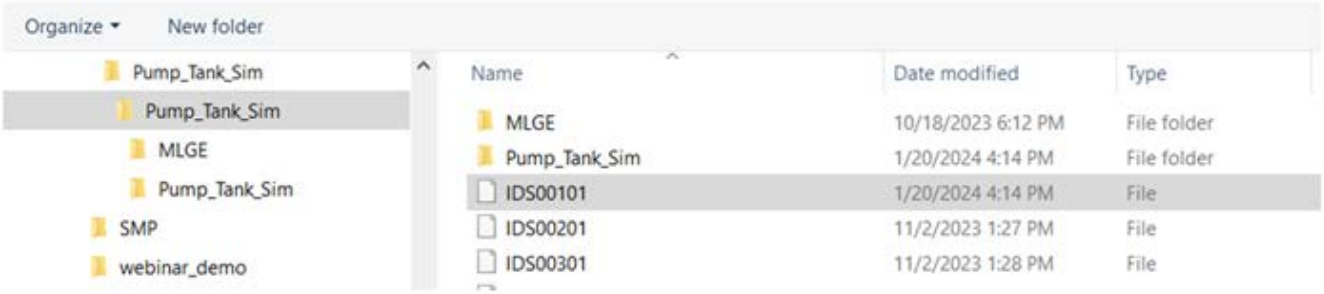
Add the variables for your automation logic in the ISaGRAF Global tag variables screen. The variables must match the data type of the tag to be mapped, and they must be set to Read attribute, as shown.

	Name	Data Type	Dimension	String Size	Initial Value	Direction	Attribute	Retained
▶	Tank_01_AL	BOOL				Var	Read/Write	☐
	Tank_01_AHH	BOOL				Var	Read/Write	☐
	Tank_01_AH	BOOL				Var	Write	☐
	R1S1pt3	INT				Var	Read	☐
	R1S1pt2	INT				Var	Read	☐
	R1S1pt1	INT				Var	Read	☐

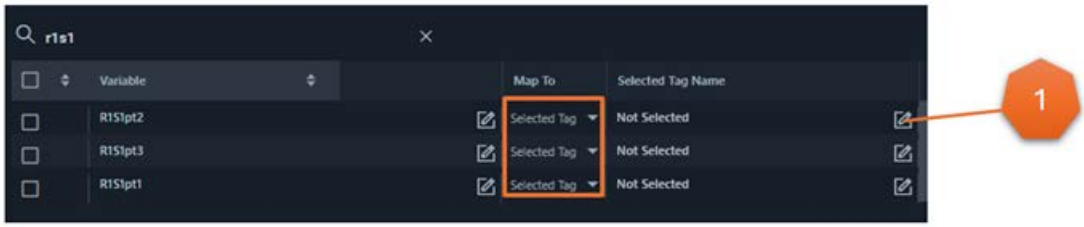
1. Download the changes to the ISaGRAF runtime environment.
2. In Unity Edge, navigate to the Deploy > ISaGRAF screen. and use the browse button (1) to locate the corresponding tag symbol file.



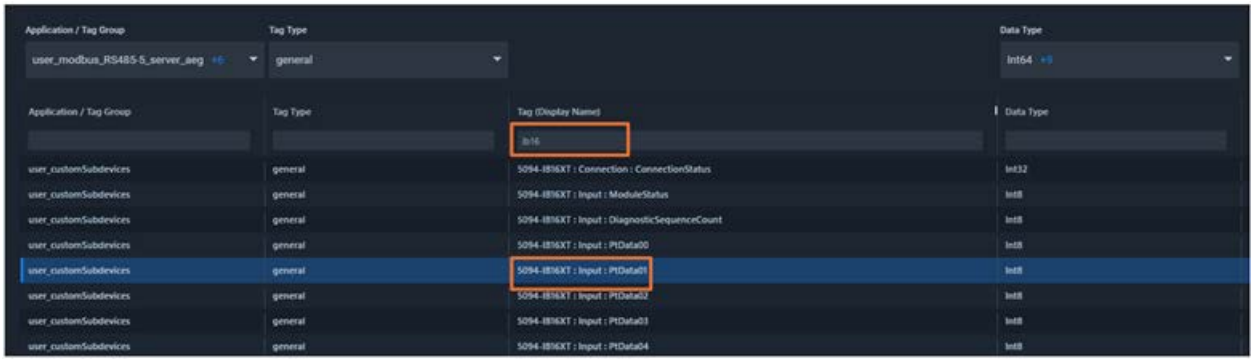
3. In ISaGRAF Workbench, browse to the location of your ISaGRAF project. The tag symbol file will be inside the ISaGRAF project file structure.
4. In the example below, the ISaGRAF project is named "Pump_Tank_Sim" and a second level directory has the same name. Inside the second level directory is an ISaGRAF symbol file named IDS00101.
5. Choose the IDS file based on the number of the resource you have assigned in ISAGRAF as shown. Resource 1 tag data will be in IDS00101, and Resource 2 tag data will be in IDS00201, etc. This will load the tag symbol file.



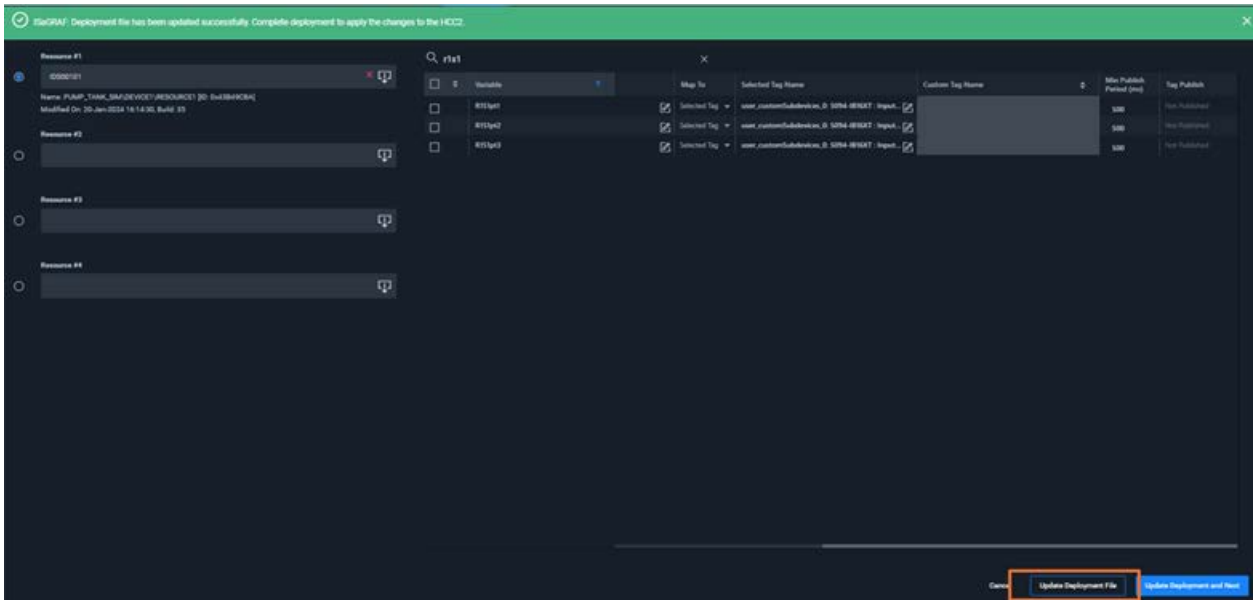
6. View the ISaGRAF tags in Unity Edge and enable them to be mapped to I/O data as described below.
   a. Use the filter box to filter the tags and view just the I/O tags (in this case we are filtering by R1S1).
   b. Check the box on the left next to each tag name to be mapped.
   c. Scroll to the right, and make sure the Map To field is set to "Selected Tag". Click on the tag browser button (1) to select the I/O point tag.



7. In the tag browser window, type the name of the I/O module into the tag name filter to show only the relevant tags from the Subdevice.
8. Then double click the I/O tag desired to map it to the ISaGRAF tag.

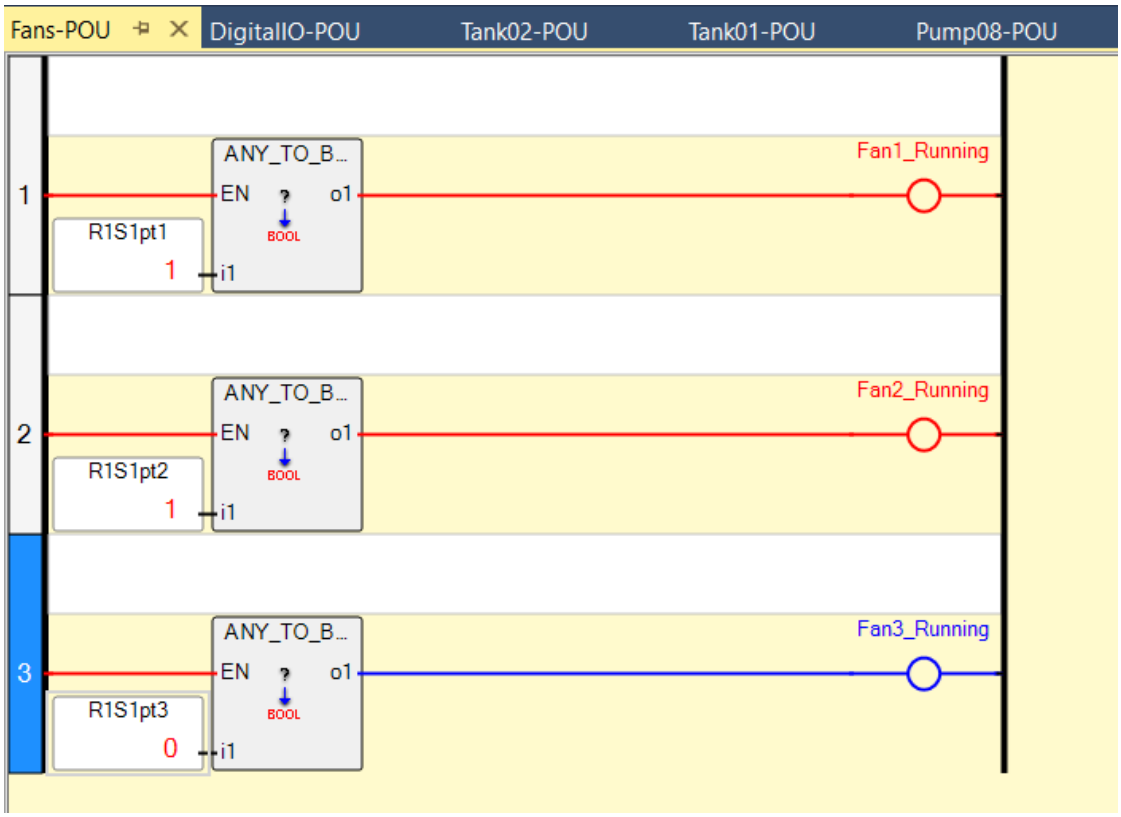


9. Repeat steps 6, 7, and 8 to map all three I/O points in our logic example.
10. Click the Update Deployment File button.



11. Then click Deploy in the Unity Edge navigation tree to deploy the mapping to runtime.

12. Return to ISaGRAF Workbench to view the I/O tag value in the logic.



Conclusion

Subdevices allow users to expand I/O to fit the needs of a process. The HCC2 utilizes Rockwell Automation FLEX™ I/O and, FLEX 5000® I/O to provide flexible I/O compatible with many different instruments.

When designing an HCC2 control system with subdevices, consider the Ethernet/IP network design guides from Rockwell Automation. If a DLR network is required, include a device that supports Ring Supervisor. The HCC2 has a 32-connection limit, which includes adapters and I/O modules. Some I/O modules (for example, HART AI modules) may consume two connections.