DF1 peer-to-peer with the Digi One IAP

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Contents

1 Introduction

Abstract

This document outlines how to use Digi One IAP device servers to connect Allen-Bradley (Rockwell Automation) PLCs in a peer-to-peer network over Ethernet. Peer-to-peer functionality can also be combined with the Digi One IAP's multi-master capability and other enhanced features to create a robust, flexible industrial automation solution. Peer-to-peer plus multi-master allows the PLCs to communicate with each other while applications such as RSLinx/Logix, HMI, and OPC still maintain communication with the PLC.

Peer-to-peer communication means that a PLC behaves as master and slave. For example, a PLC can poll and/or be polled.

There are two prerequisites to use this document. First, the Digi One IAP is running firmware revision E or later and, second, that you have assigned the Digi device an IP address. Information on upgrading and assigning IP addresses can be found in the *Digi One IAP Family User Guide* and *Digi One and PortServer TS Family Command Reference*.

Note The Digi One IAP has a pass-through switch. With this switch on, the Digi device is a two-port unit where:

- Port 1 is the screw terminal and can be EIA-232, 422, or 485
- Port 2 is the DB-9 and is EIA-232 only

With the pass-through off, the screw terminal and DB-9 serial port are tied together. They are configurable as EIA-232, 422 or 485.

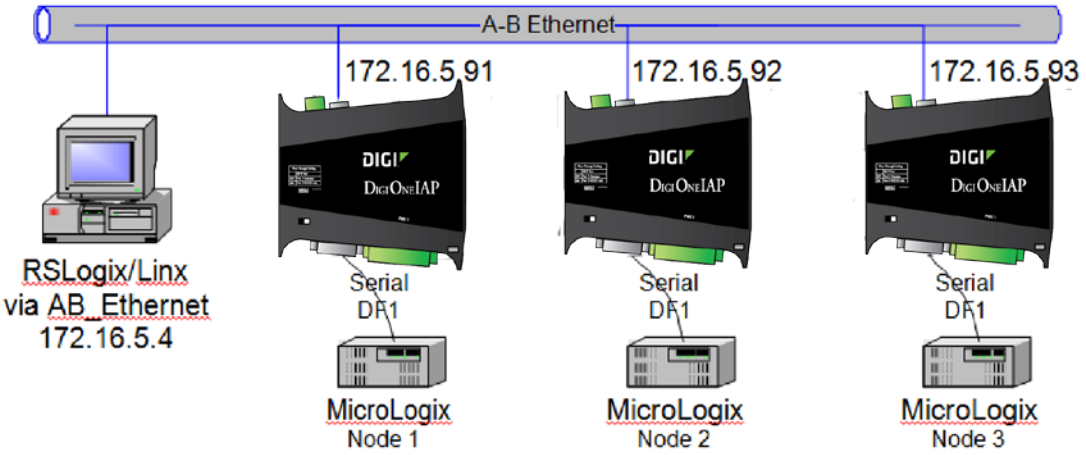
This example setup uses three Allen-Bradley MicroLogix 1000 PLCs using serial DF1 ports. The Digi One IAP will bridge DF1 to A-B Ethernet.

Each PLC will be configured to read data from its peer's N7 register while at the same time allowing a peer to read from it. Writes are also allowed.

Communication from the PLC is accomplished using MSG block commands. Simple timers are used to trigger the MSG commands on the reading PLC.

Digital or other inputs could also be used to trigger the reads. Counters are used to provide data.

1.1 PLC peer-to-peer network



In this example, the Digi One IAPs will be in two-port mode and the PLCs will be attached to port 2 (DB-9) mainly because the MicroLogix's cable is a DB-9. This allows an HMI, bar-code scanner, or a second PLC to be connected to port 1.

1.2 Theory of operation

The Digi One IAP provides serial to Ethernet connectivity plus it can bridge DF1 full-duplex to Allen-Bradley Ethernet or EtherNet/IP. For this example, the Digi One IAP will be configured to bridge serial DF1 to A-B Ethernet.

You can use Ethernet/IP, but A-B Ethernet is more efficient and more readily accessible from various versions of RSLinx.

The Digi One IAP supports this application because it is A-B protocol-aware. It understands the protocol requests, responses, and node addressing.

Setup is easy. Serial ports attached to PLCs are configured as message sources using DF1 full-duplex masters.

Allen-Bradley Ethernet must also be configured as a message source. This will allow routing from two A-B Ethernet sources:

- RSLinx/RSLogix
- The peer PLCs

Applications such as RSLinx/RSLogix, OPC, and HMI can also simultaneously access the PLC attached to a Digi One IAP serial port. The Digi One IAP's multi-master engine makes this possible.

Digi One IAPs support for IA-routing tables provide more flexibility for configuring and controlling IA protocol routing. You can easily limit or allow certain protocol addresses to a destination.

For this example, there are three MicroLogix 1000 PLCs connected to three Digi One IAP servers. Make note of the PLC node numbers and the IP addresses of the Digi servers. Communication from PLC to PLC is accomplished by MSG blocks. Each MSG block contains the node number of the destination PLC. The Digi One IAP configuration will direct messages based on the PLC node number to the IP address of the associated Digi device.

RSLinx must be configured in a similar fashion. For example, enter each PLC's Node and Digi One IAP IP address in the A-B Ethernet driver configuration. This configuration is explained below.

Each node is configured to read a register from its peer: Peer 1 will read from Peer 2, Peer 2 from Peer 3, and Peer 3 will read from Peer 1.

2 Digi One IAP configuration steps

2.1 Configure pass-through port as needed

Enable the two-port mode by setting the pass-through port to **On**.

Enable the one-port mode by setting the pass-through port to **Off** (default from factory). The unit must be power-cycled for the change to take effect.

Note If you leave the unit in its default one-port mode, any reference in this document to serial port 2 must be changed to port 1.

2.2 Connect PLC(s)

Depending on the PLC, it may be easier to use the DB-9 serial port vs. the screw terminal port. Some PLCs, such as the MicroLogix used in this example, can use a standard RS-232 cable to the Digi's DB-9 serial port. Just remember, with pass-through enabled, the screw terminal is port 1 and the DB-9 serial port is port 2.

2.3 Assign an IP address

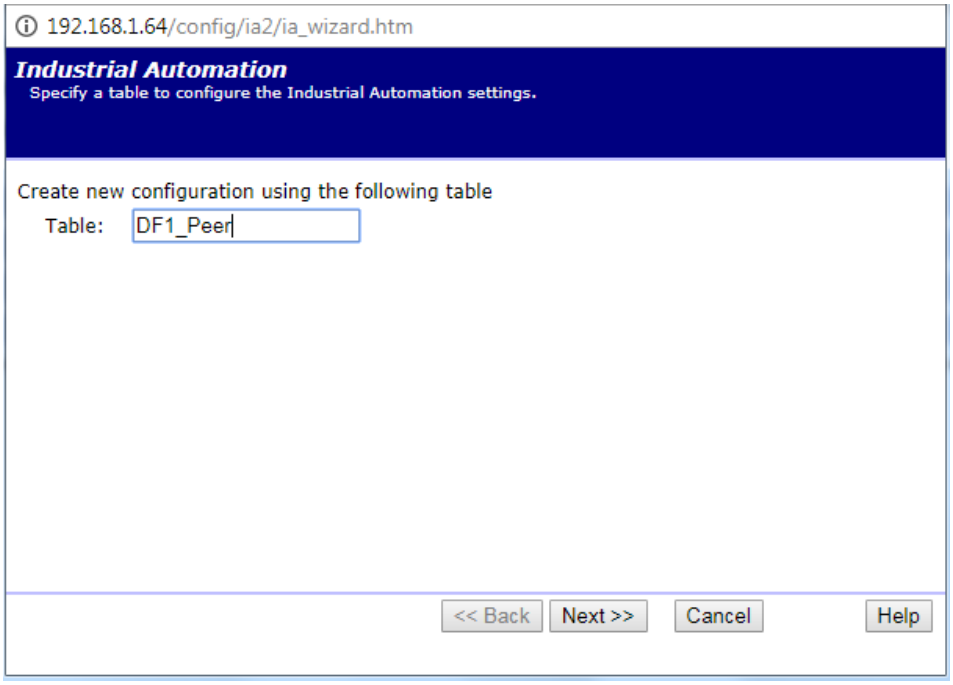
The Digi One IAP supports several methods for IP address assignment. These methods are outlined in the *Digi One Family Quick Start Guide* and *Digi One Family User Guide*. DHCP is the default method. In most cases, a static IP address is preferred.

2.4 DF1 peer-to-peer setup via web UI

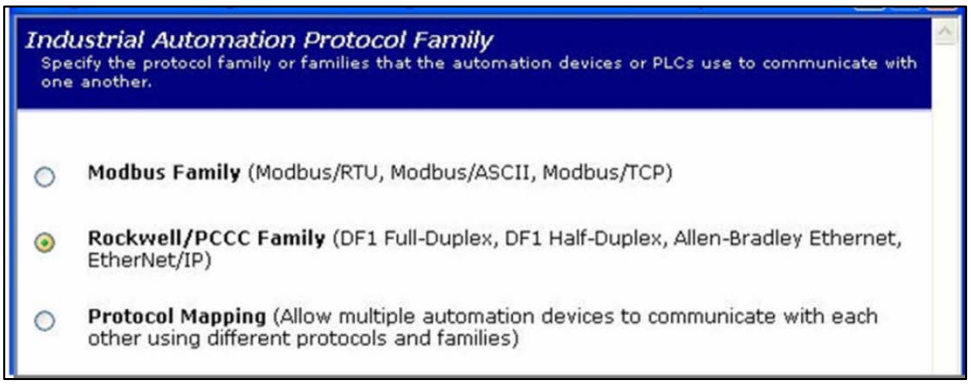
1. Open a web browser and point to the IP address of the Digi device.
2. Log in as **root** with the default password **dbps**.
3. Select **Industrial Automation > Industrial Automation Wizard**.

The wizard walks you through building a message-routing table.

4. Name the table. This example uses the name **DF1_Peer**.



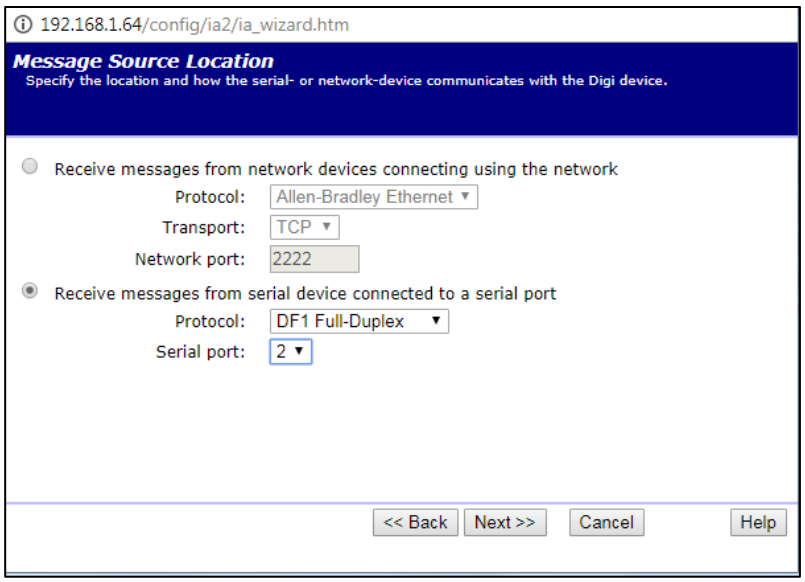
5. Click **Next**.
6. Select Rockwell/PCCC Family.



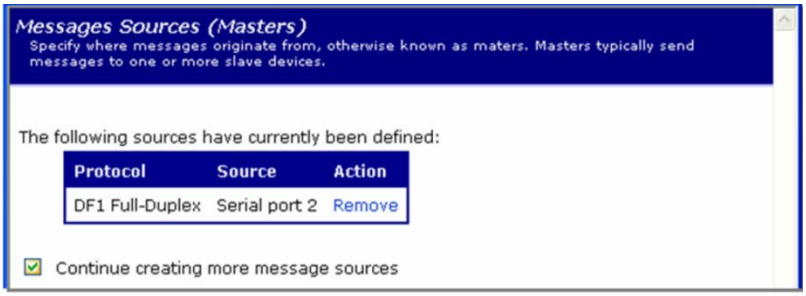
2.4.1 Creating message sources

1. The next screen describes setting up message sources.

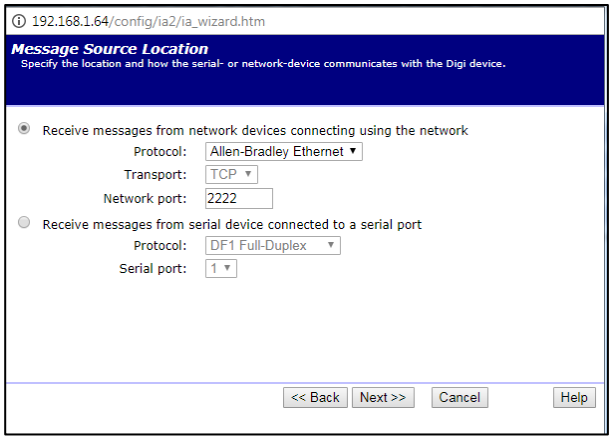
   The first message source will be the PLC attached to serial port 2.
2. In this case, select **DF1 Full-Duplex** on serial port 2:



3. Set the serial settings to match the PLC (typically 19200 or 9600 baud, 8 data, no parity, 1 stop, no flow control).
4. Configure checksum (typically CRC) and error responses as applicable for your application (default is usually okay).
5. Adjust message and character timeouts as needed (defaults are usually okay but may need to be adjusted based on message length and timing).
6. Add a **Message source** from the **network**, in this case Allen-Bradley Ethernet. This allows the other PLCs and RSLinx to access this PLC as needed.
7. Continue adding message destinations by checking **Continue creating more message sources**.



8. Click **Next**.
9. Add a message source for Allen-Bradley Ethernet:



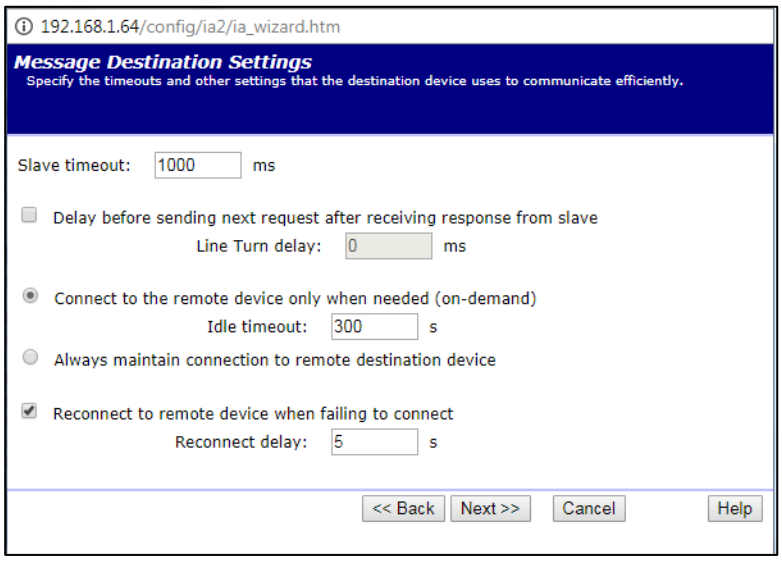
10. Click **Next**.
11. Leave **Enable error responses when unable to reach destination or requests time out** checked. If you do not want error messages, uncheck the box.
12. Adjust message and character timeouts as needed (defaults are usually okay, but can be adjusted later if needed) as well as **Idle Timeout**.
13. Click **Next**.
14. You are finished creating message sources.
15. Clear the **Continue creating more message sources** box to stop adding sources.
16. Click **Next** and leave the default to **Assign all masters the same level of priority**.

2.4.2 Create message destinations (peers)

1. Click **Next** to begin creating message destinations.
2. Read the description of the steps then click **Next**. You are currently configuring Node 1 attached to 172.16.5.91, so messages will be sent to Node 2 at IP addresses 172.16.5.92.
3. Create routes so that only those node addresses are examined and routed.
4. Here is the route creation to Node 2.

5. Select **Allen-Bradley Ethernet** and the IP address of the Digi One IAP device attached to Node 2 (172.16.5.92):

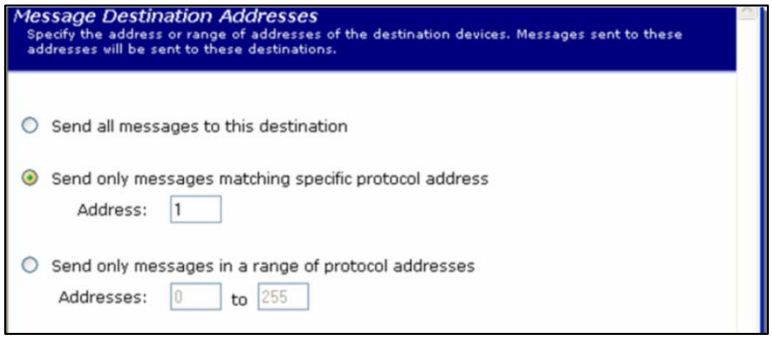
6. Configure timeouts and when to connect. In this case, leave the default to maintain a permanent connection.



This shows the completed route.

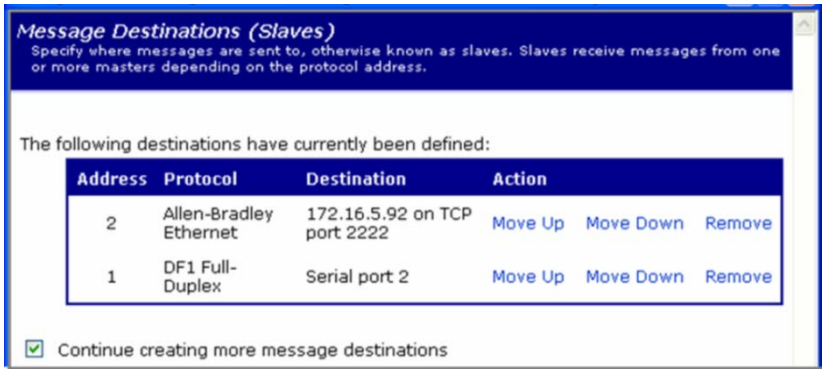
7. Check the **Continue creating more message sources** box to add the route to Node 3.

8. Add one more route. This route allows other peers and masters (such as RSLinx) to access the PLC on serial port 2. Use Node 1 here:

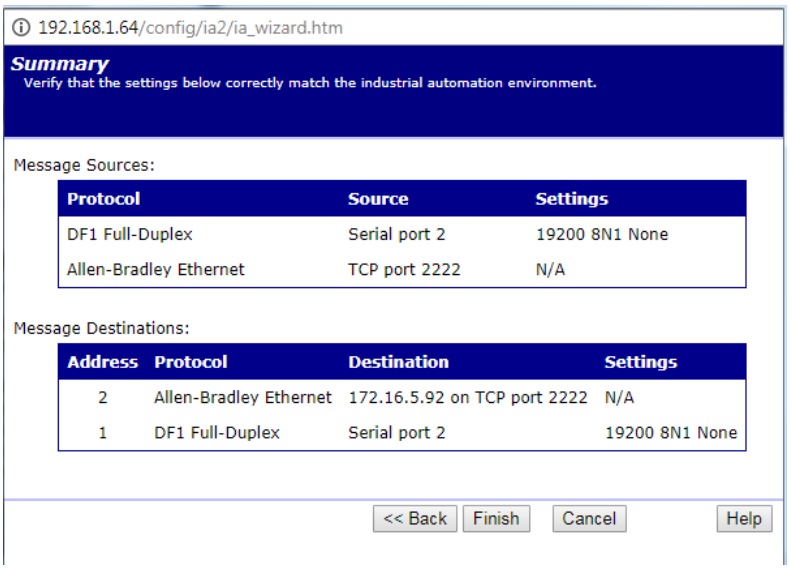


9. Click **Next**.
10. Select **DF1 Full-Duplex** on serial port 2.

11. Click **Next** and enter a slave timeout if different from the default.
12. Clear the **Continue creating more message sources** box to exit the route creation. You should see a window like this:



13. Click **Next** and review your route settings.



2.5 Backup

Follow these steps to create a backup:

1. Select a folder.
2. Enter a descriptive file name.

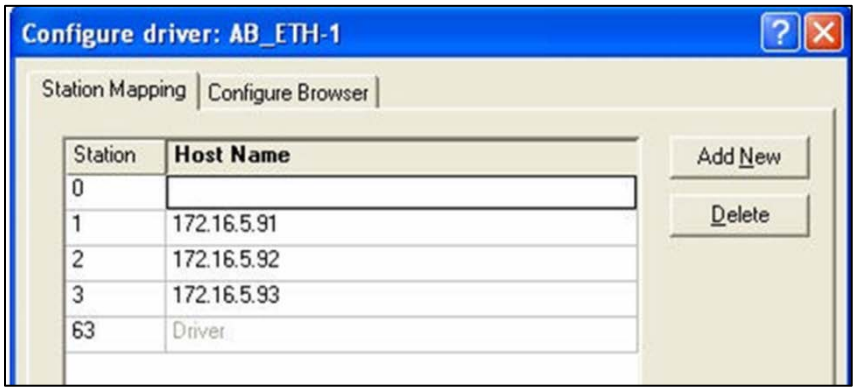
This is an ASCII text file that can be used to restore the configuration to this unit, or to load a duplicate configuration to a new Digi One IAP server. It can also be copied and edited to create a new configuration to a new or backup unit. This is useful when configuring from the command line.

See Using and copying to/from the command line for copying configurations from the command line or by using the restore utility.

3 Configuring the MicroLogix PLC for message blocks

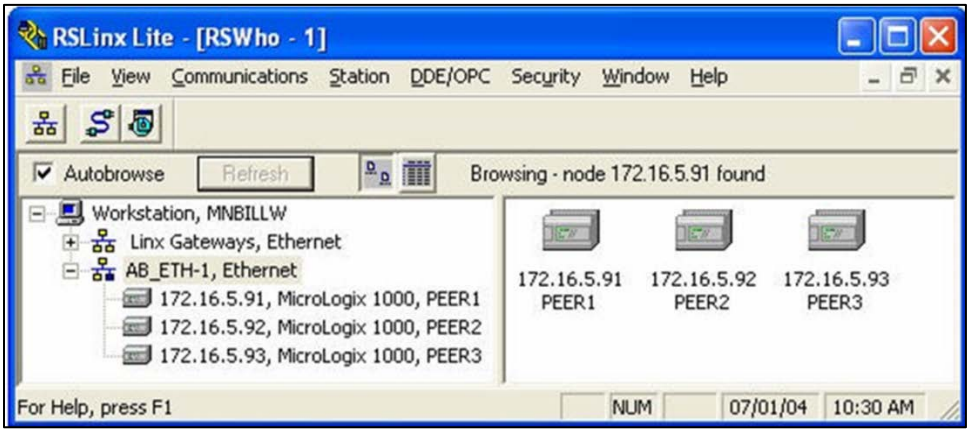
3.1 Set up Digi One IAP destinations in RSLinx

1. In RSLinx select Communications > Configure Drivers.
2. Select Ethernet Devices from the available driver types.
3. Choose a name (default of AB_Eth-1 is okay).
4. Select Add New.
5. Add the three Digi One IAP device servers. Be careful to identify each IP address with the appropriate Station (Node).



Note When the program is saved, the MicroLogix PLC will use this node address to tell the Digi One IAP device how to route the traffic.

6. Use the RSLinx Browser to ensure the PLCs can be accessed.



Note The Digi One IAP device will show with an “X” as an unrecognizable device if it is not connected, no PLC is attached, or is incorrectly configured (for example, AB Ethernet has not

been allowed as a master or the serial port data rate is wrong). Correct the problem and browse again.

3.2 Program the PLC to send peer info via message blocks

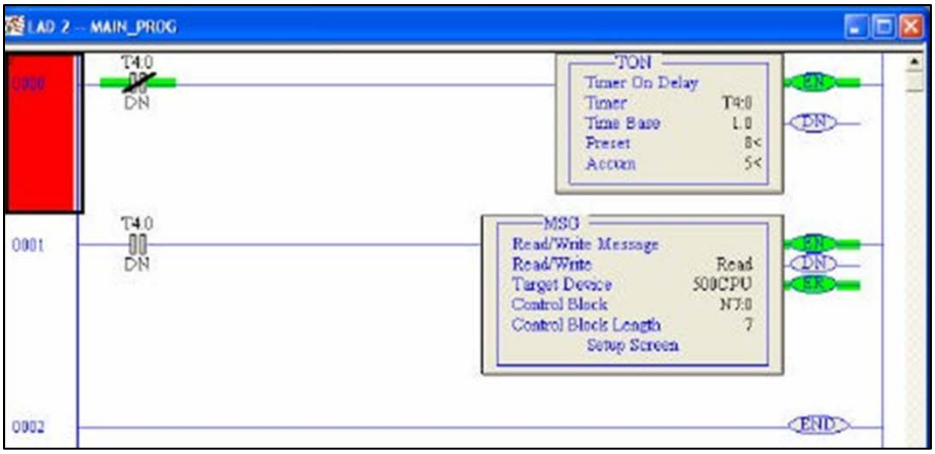
Recall the sample setup: Node 1 (IP 172.16.5.91) will read from Node 2 (IP 172.16.5.92); Node 2 will read from Node 3 (IP 172.16.5.91); and Node 3 will read from Node 1.

1. Set up the PLC.

A simple timer will be used to trigger a MSG block which will read from the peer's N7:20 (into which you will manually enter some data via RSLogix) and place this data in its N7:10. Use N7:0 for the control block.

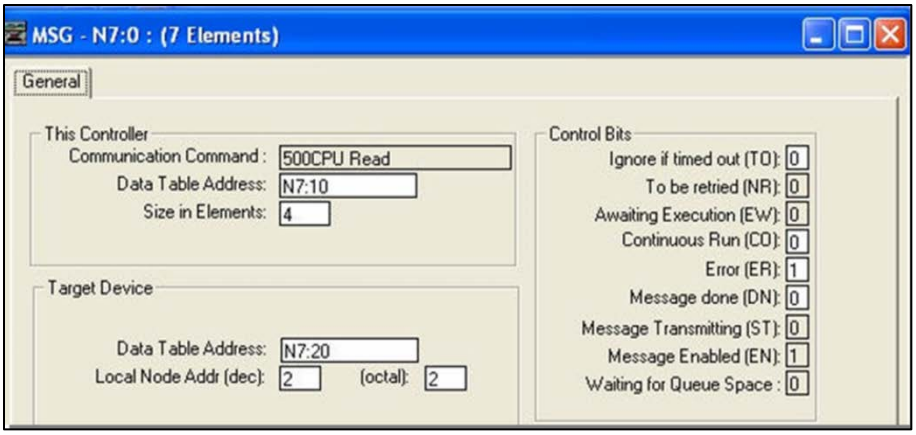
All three PLCs will be set up identically to illustrate how this works. The only differences will be which node is entered in the MSG setup screen in the target device configuration's local node address.

- Rung 0 is a timer that controls the scan time and loops continuously.
- Rung 1 reads from its peer node.



Notice the Control Block addressing. Make the Size in Elements 4.

This is the sample MSG setup for rung 1 on peer 1 to read from peer 2:



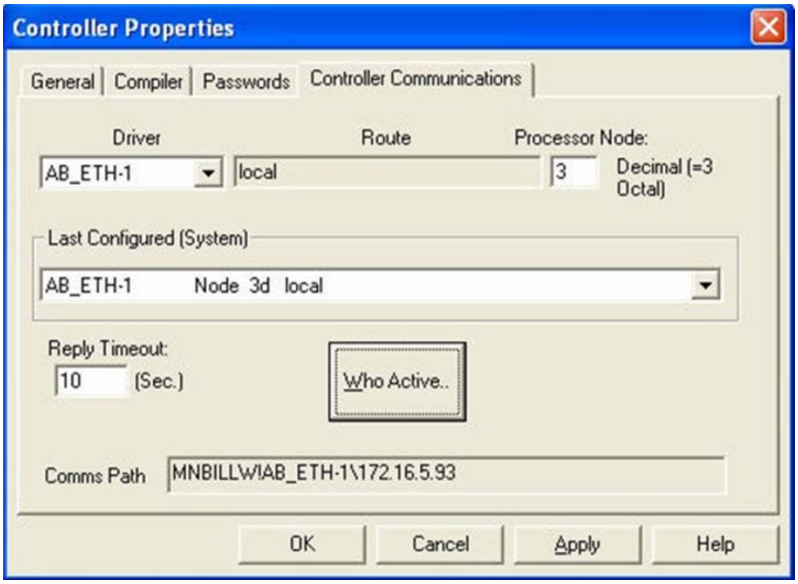
Remember that in this case "Target Device" is the node being read *from*. Conversely if you use a write command, write to the **Target Device** from **This Controller**.

2. Check/change **PLC Node** assignment.

You can upload Node 1's program file to Nodes 2 and 3. The Node and IP address settings must be changed in **Controller Properties**.

To change the node and protocol settings, double-click **Controller Properties** from the project window. Under the **General** Tab, change the **Processor Name** to match the new destination (e.g. Peer2). Here you can also change the processor type. This may require you to change some of the functions. For example, MicroLogix 1200 supports peer-to-peer MSG blocks, whereas 1000s only support read/write MSGs.

Select the **Controller Communications** tab. If you are copying Node 1's program to Node 3, change the **Processor Node** to 3. Click the **Who Active**… button to browse the connected PLCs and select **Node 3** at 172.16.5.93. It should show:



You can now download this program to the new PLC (e.g. Node 3).

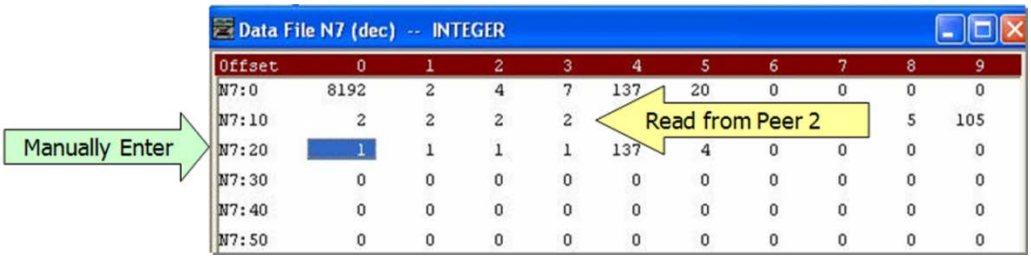
3. Test the setup.

Make sure the PLCs are in **Run** mode. The LAN activity LEDs on the Digi One IAP devices should be blinking, indicating traffic. (Note that port 2's serial activity will not show on the LEDs when in pass-through mode.)

Start three instances of RSLogix and go online to Nodes 1, 2 and 3. Enter data, such as the Node number in to N7:20 on each PLC. This data should be read by its peer.

4. For example:
    1. On Node 1 select **Data Files** and double click **N7 – Integer**.
    2. Go to N7:20/0, change to decimal mode and enter the number 1 four times.
    3. This same string should appear in Node 3's N7:10.
    4. Do the same for Nodes 2 and 3.

Node 1's N7 looks like the following image after reading from Peer 2:



Go online to the other peers and change values in N7:20. Observe how they change on the peer reading from it.

Note You could easily have Node 1 writing to Node 3, or any combination of reads and writes. The above example is a simple peer-to-peer setup illustrating how to set up the Digi One IAP device for peer-to-peer.

4 Troubleshooting

- Node addresses must be mapped in RSLinx to the appropriate IP address. Double check to make sure this is the case.
- Serial port settings must match those of the PLC. For example, if the PLC is configured for 9600 baud and the serial port on the Digi One IAP device is set for 19,200, RSLinx will show the device as unrecognized.
- Your Digi One IAP device (or IA RealPort device) does not appear to have this capability. You must have firmware release E (or later) and POST release D or later to support these capabilities. Go to www.digi.com/support and download the appropriate firmware and POST. Install the POST first.
- Make sure you back up the configuration once you have a working configuration. Sometimes it is helpful to clear the configuration and start over. There are two main methods to clear the configuration:
    - Web UI: **Select Administration** > **Factory Default Settings CLI: revert all=factory** (this will also clear the IP settings).
    - To clear just the IA configuration enter **revert ia=factory**.

5 Using and copying to/from the command line

The Digi One IAP offers a command line interface that is accessible via telnet, rlogin, and even a serial port (serial port connections are available in factory default mode—for example, an unconfigured profile—or when in terminal mode). You can use HyperTerminal which supports telnet (select **WinSock** and use TCP port 23) or via COM 1 or 2 on the PC to an unused Digi One IAP serial port.

TIP For command details, refer to the *Digi One and PortServer TS Command Reference*.

1. Connect to the Digi One IAP via telnet or serial port. Login as **root**. The default password is **dbps**.
    1. Copy the IA settings from the backup file you created above or enter them manually.

       Other than assigning the IP address, the only entries that need entering are items that change from factory default. These items include serial and IA settings.
    2. Set these serial port parameters for port 2:

```
set line range=2 parity=N csize=8 error=ignore
```

```
set line range=2 baud=19200 stopb=1 break=ignore inpck=off istrip=off set line range=2
onlcr=off otab=off

set flow range=2 ixon=off aixon=off ixoff=off ixany=off itoss=off set flow range=2 altpin=off
forcedcd=off

set flow range=2 dtr=off cts=off dcd=off dsr=off ri=off set flow range=2 rts=off pre-delay=0
post-delay=0

set port range=2 dev=ia sess=4 termtype="vt100" edelay=1 auto=off bin=off
```

3. Set these IA parameters (# lines are comments and can be pasted without harm):

```
# Set serial port 2 to be a DF1 full-duplex master set ia serial=2 protocol=df1fullduplex
type=master
set ia serial=2 chartimeout=50ms table=1 messagetimeout=2500ms set ia serial=2 priority=medium
checksum=crc errorresponse=off set ia serial=2 duplicatedetect=on acktimeout=250ms acklimit=3
set ia serial=2 naklimit=3 target=slc5

# Set a master to be A-B Ethernet
set ia master=1 active=on protocol=abethernet transport=tcp ipport=2222 set ia master=1
table=1 chartimeout=50ms messagetimeout=2500ms
set ia master=1 idletimeout=1min priority=medium permit=all set ia master=1 errorresponse=on
target=slc5

# IA Routing table for Peer1

# Route 1 is to PLC Peer2 attached to DOIAP at 172.16.5.92 set ia table=1 name=Peer1
set ia table=1 addroute=1 active=on protocol=abethernet
set ia table=1 route=1 protaddr=2 type=ip ipaddress=172.16.5.92 set ia table=1 route=1
ipport=2222 transport=tcp
set ia table=1 route=1 connect=active idletimeout=0ms
set ia table=1 route=1 reconnecttimeout=5sec chartimeout=50ms
set ia table=1 route=1 slavetimeout=1sec errorresponse=on target=slc5

# Route 2 is to PLC Peer1 attached to this DOIAP
set ia table=1 addroute=2 active=on protocol=df1fullduplex set ia table=1 route=2 protaddr=1
type=serial port=2
```

4. Enter **show ia all** from the command line to verify the IA settings. You should see something like:

```
#> sh ia all
serial=1 active=off
```

```
serial=2 active=on protocol=df1fullduplex type=master chartimeout=50ms table=1
messagetimeout=2500ms checksum=crc errorresponse=off acktimeout=250ms

master=1 active=on protocol=abethernet transport=tcp ipport=2222 table=1 chartimeout=50ms
messagetimeout=2500ms idletimeout=1min errorresponse=on target=slc5

routetable=1 name=Peer1
route=1 active=on protocol=abethernet protaddr=2 type=ip ipaddress=172.16.5.92
ipport=2222 transport=tcp connect=active idletimeout=0ms reconnecttimeout=5sec
chartimeout=50ms slavetimeout=1sec errorresponse=on target=slc5

route=2 active=on protocol=df1fullduplex protaddr=1 type=serial port=2
```

5. Use the settings above as a template for configuring nodes 2 and 3. Simply edit the file with a text editor and change the destination node and IP address info as needed.
6. To clear all IA settings from the command line, enter **revert ia=factory**.

   Contact Digi Technical Support at tech.support@digi.com if you need additional help or information.