



Setting up DigiOne-IAP for Rockwell Bridging, including linking a serial PLC & serial HMI

Keywords: IA, DigiOne, DigiOne-IAP, Pass-Thru, Rockwell, Allen-Bradley, Allen Bradley, AB, DF1, ControlLogix, MicroLogix, PanelView

Abstract: This application note explains how to setup the DigiOne-IAP's pass-thru port to connect an Allen-Bradley PanelView 300 Micro (or other DF1 "Master") to a SLC 5/03 PLC (or other DF1 "Slave"). This guide shows how to set up 1) Network Masters, 2) Serial Masters, 3) Network Slaves, and 4) Serial Slaves. After understanding this guide you should be able to combine these into a full variety of configurations including enabling the PLC to issue MSG blocks to remote devices including other DigiOne-IAP, ControlLogix, PLC5, SLC5/05, and 1761-NET-ENI modules.



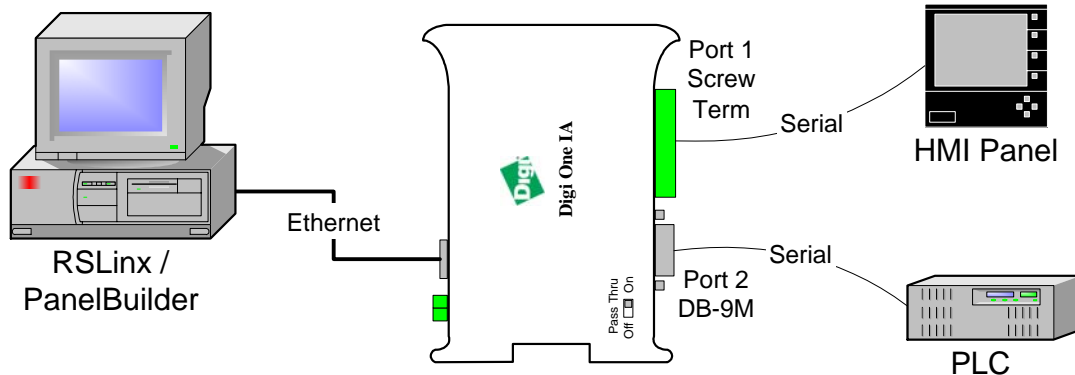
1. Introduction

NOTE: This document assumes the HMI and PLC are pre-programmed and the DigiOne-IAP's Ethernet interface is configured. If you require additional assistance in configuring the DigiOne-IAP, please refer to the documentation on the CD that ships with the product or check Digi's support web site at <http://www.digi.com/support/ia>.

1.1. Example Application

You have an existing system with a serial master and single-port slave – for example a local HMI and low-end PLC. The DigiOne-IAP allows you to retrofit this system so that the serial master can share this slave with the world.

Note this diagram shows the HMI connected to the screw terminal serial port and the PLC to the DB-9 port. Depending on your needs, this can be reversed. The order does not matter but you need to adjust the steps shown as appropriate.



In this example we pull a local HMI or operator panel on port 1 and a single-port PLC on port 2. When pass-thru is enabled:

- 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.

1.2. Theory of Operations

The DigiOne-IAP supports this application because it is Rockwell protocol aware. It understands DF1, Ab/Ethernet (CSP) and Ethernet/IP requests and responses. It also understands how slave or destination addresses are added.

Given this understanding, the DigiOne-IAP is able to act a bit like a “network print server” – it can juggle & interleave requests from many masters to many slaves. Requests from the HMI are understood to be destined for the PLC (or can even be for remote PLC). Some is true of requests from remote RSLinx, remote AB processors, or even MSG block requests from the “slave PLC”.



2. Setup (firmware D1 or E)

2.1. Enable Pass-Thru Port

Power off the DigiOne-IAP.

Set the "Pass Thru" DIP-switch to ON. This lone DIP-switch is on the side of the unit opposite the MAC address and serial number labels. It is NOT in the 4-switch block used for EIA-232/485 selection!

Power on the DigiOne-IAP. The "Pass Thru" DIP-switch is ONLY read during boot up, so changing it while the unit is powered has no effect.

2.2. Connect your devices

The HMI and PLC can be connected to either physical serial interface. This document assumes that the HMI is on the 'screw terminal' block and the PLC is connected via the 'DB-9' connector. If you connect in the opposite order you'll just need to modify the steps below as necessary.

2.3. Configure the DigiOne-IAP

You have 2 options for configuring the DigiOne-IAP. You can use your web browser to access a Web Wizard, or you can use HyperTerminal (or any telnet/comms app) to access the DigiOne-IAP by TCP port 23.

You will log in as root, where the default password is "dbps".



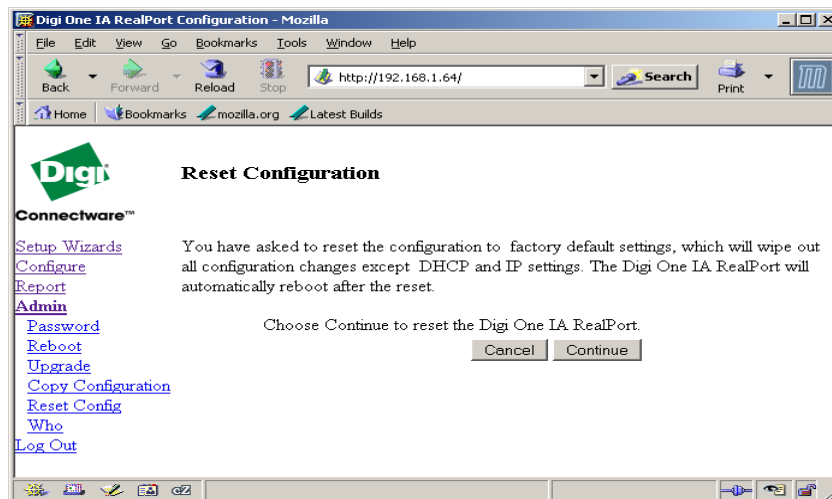
3. Web Setup (firmware D1 only)

This application works with either firmware D1 (from Nov 2003) or firmware E (from May 2004). The setup is slightly different, so follow the correct section below. However note that firmware E has many Rockwell and Ethernet/IP related enhancements, so you'll likely desire upgrading.

WARNING: firmware A, B, or D should NOT be used with Rockwell protocols. RSLinx 2.41 will cause these units to reboot periodically. All DigiOne-IAP for use with RSLinx must be upgraded to at least release D1 or E !!

3.1. Do you need to Reset the Confi?

If you have any doubts about what is configured in the DigiOne-IAP, then it is best to first go to the **Admin** and select the **Reset Config** option. Press the **Continue** button to do the reset. This reset is important because some of the non-IA settings affect IA protocol behavior. This is wonderful if you need special behavior, but can be disastrous if you don't expect any special behavior!



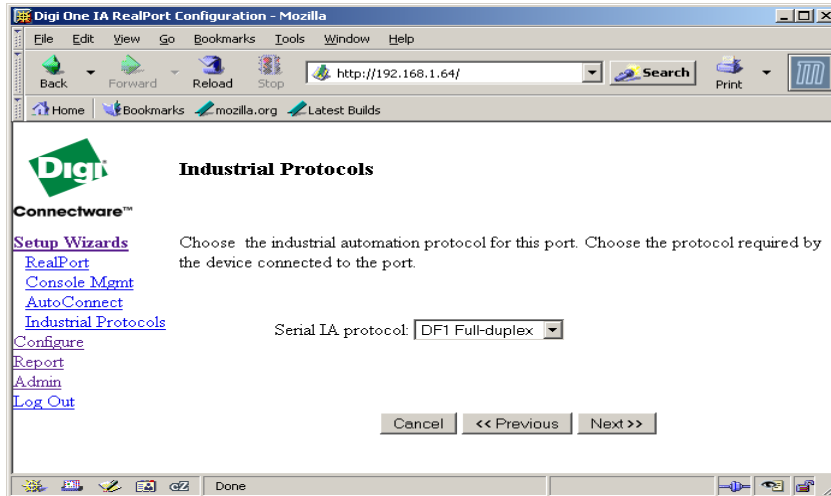
3.2. Start Web Wizard

At the left of the web interface, select **Setup Wizards** and then **Industrial Protocols**. A series of pages will show up – they are fairly self-explanatory and you can hit “Next” to go on or “Previous” to back-track.



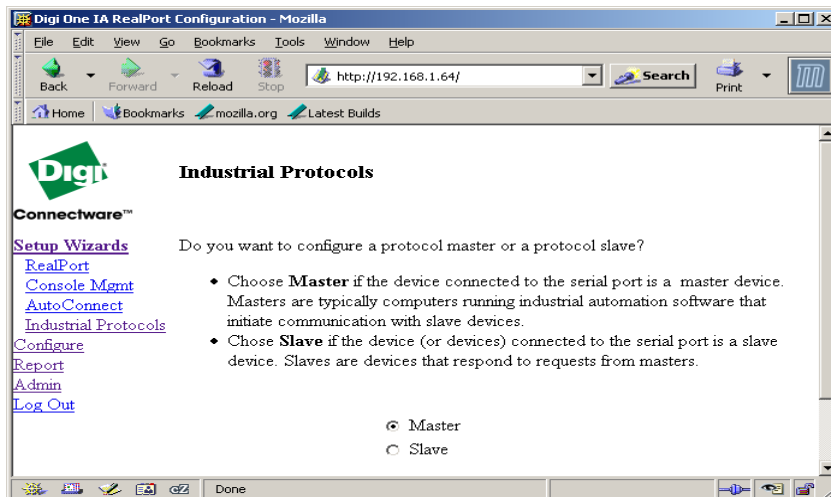
3.3. Configure Serial Port #1 (Screw terminals / HMI)

When asked, select **Port 1**. Next you'll be asked to set the port characteristics – we want to change to 19200. Then you'll be asked to select a DF Full-Duplex and the CRC method (CRC or BCC)



We call the HMI a Master because it issues DF1 message requests. When we do port 2 we'll be calling the PLC a Slave. But here click **Master** and **Next**.

Note that with firmware release E you'll call *both* the HMI and PLC Masters since they both can issue or respond to messages – this may be a good reason to upgrade your firmware if you want to use MSG blocks with the PLC

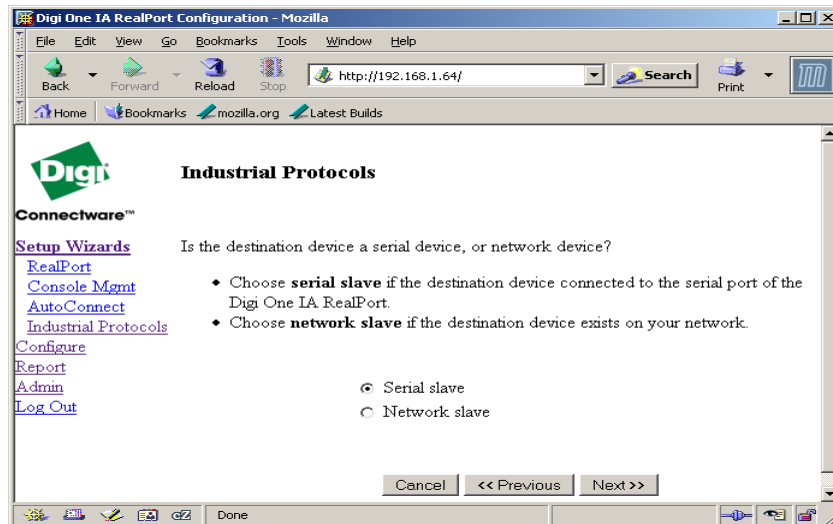




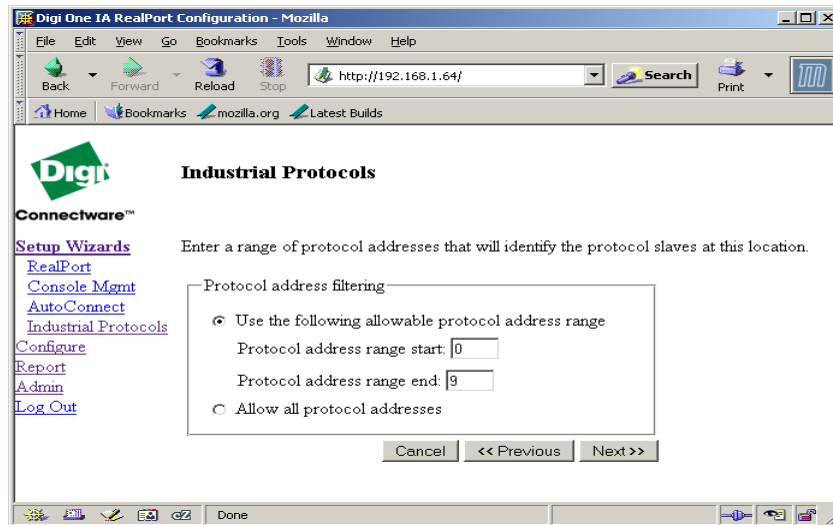
3.4. Configure the Destination (Route) Table

Since we called the HMI a Master, we are now being asked how to forward or route the DF1 messages it sends based on the DF1 DST field. Flexibility with the DST byte in DF1 Full-Duplex is a bit fuzzy – some Rockwell products just force it to 1 (like RSLinx), while other let you set any value 0-63 or even 0-254.

In our example, we'll just be routing DST=1 to our PLC. So on the next few pages, select Serial Slave, Port 1, and DF1 Full-Duplex. You can also enter a name or comment for the route to help you remember it later.



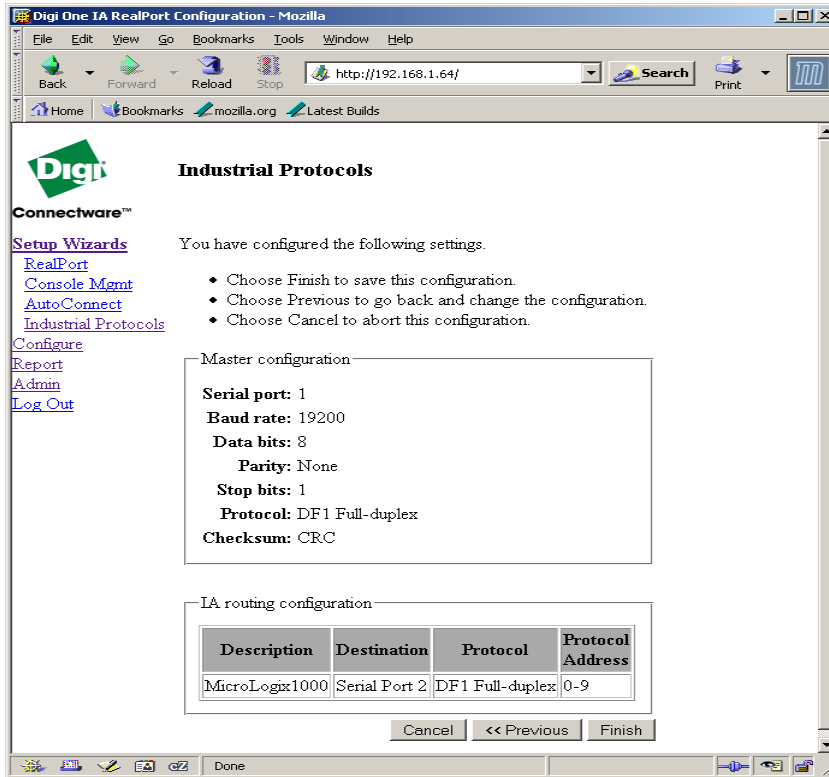
We want to use an address range of 0-9 for our PLC even though we call it DST=1. This is because when RSLinx uses AB/Ethernet or CSP it will set the DST number to a table index. (See Troubleshooting section for details)



When asked "Do you want to configure another route?", say **NO finish the Wizard** - we are done for the HMI. However, you could create up to 11 more destinations as Network slaves that allow the HMI to use DF1 to poll up to 11

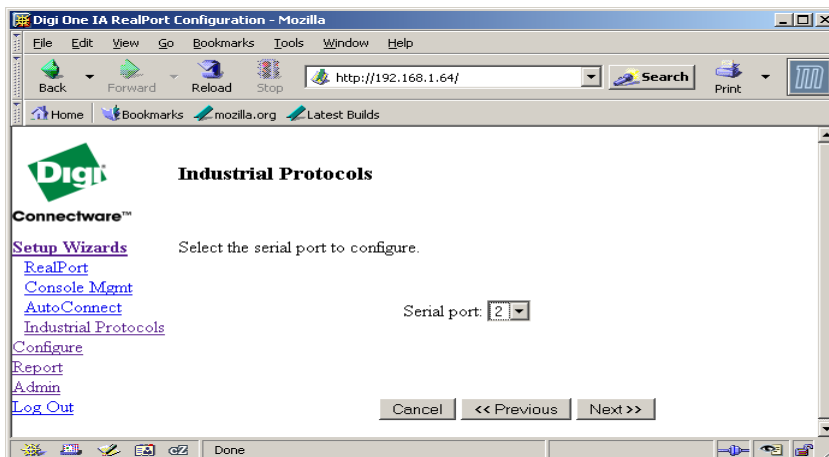


remote DigiOne-IAP or even AB/Ethernet (CSP) PLC such as PLC5E or SLC5/05. We leave that as an exercise for you. You'll see this summary.



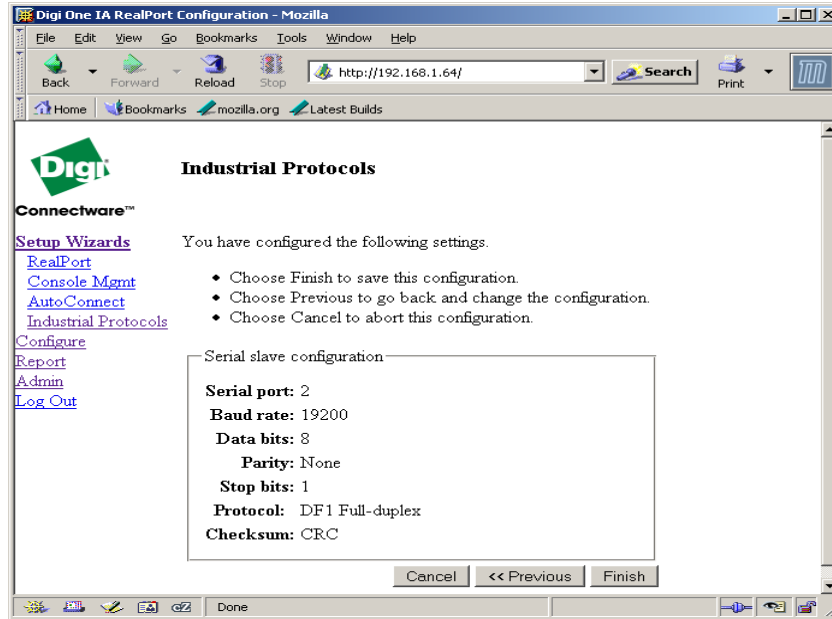
3.5. Configure Serial Port #2 (DB9 / PLC)

You'll be asked if you want to set up another serial port. We do, so click the menu item link. You'll find yourself back at this page, so select **Port 2**.





You'll be asked the same basic questions as for port #1. We want 19200 baud, DF1 Full-Duplex, CRC checksum. When finished, you'll see this summary page. Click **Finish** and we don't want to configure any more serial ports.



if you want to set up another serial port. We do, so click the **menu item** link. You'll find yourself back at this page, so select **Port 2**.

3.6. Configure incoming Network Masters

In release D you don't need to configure the incoming AB/Ethernet or Ethernet/IP masters. You can enable or disable either via the **Configure | Ports** menu. Select **Port 2** (our slave), then click the **Industrial Protocols** button, followed by the **Net Master Config** button. Here you can make either protocol active or inactive.

3.7. Reboot the DigiOne-IAP

You can make minor changes to the DigiOne-IAP configuration. However, when changing the number or type of Masters (message sources) or number or type of Slave (message destinations) it is safest to reboot. This is because these changes affect the number and type of tasks running in the DigiOne-IAP RTOS and occasionally these changes will fail to take effect correctly without a reboot.



4. Web Setup (firmware E only)

The new Web UI Wizard has changed outlook. While the release D started from the serial ports and worked “upwards”, the release E starts at where messages come from and works “downwards” towards who will answer the messages. Release E also is aimed to handle units with larger port counts – for example a 4 or 8-port unit where you could have a configuration that mimics multiple DigiOne-IAP in parallel on a single unit.

So a summary of setup with Release W Wizard:

We define a group and which protocol(s) it may contain. This allows the wizard to narrow down options faster. In this example we'll be selecting **Protocol Mapping** to retain the widest possible options.

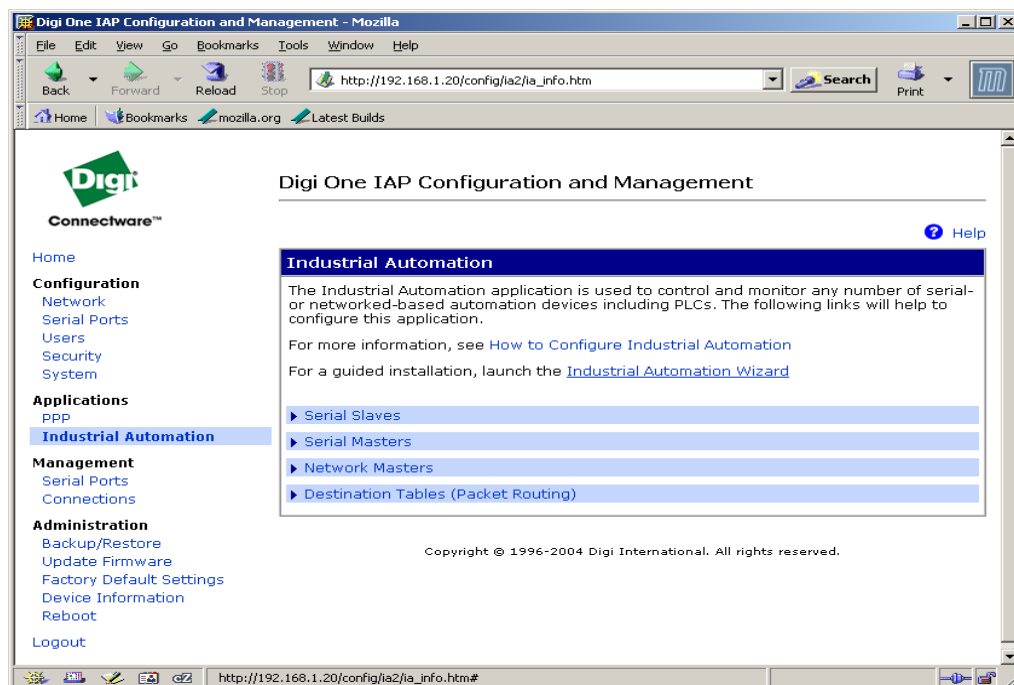
We define where messages will be coming from – in this example it is AB/Ethernet (CSP) from RSLinx and DF1 Full Duplex of the HMI

We define destinations for these messages – in this example the PLC.

WARNING: firmware A, B, or D should NOT be used with Rockwell protocols. RSLinx 2.41 will cause these units to reboot periodically. All DigiOne-IAP for use with RSLinx must be upgraded to at least release D1 or E !!

4.1. New Look-n-Feel

Those familiar with the older firmware should notice the new Web UI has a much more polished look-n-feel. Click the **Industrial Automation** link under **Applications**, then you can start the **Industrial Automation Wizard**.





4.2. Select the Group – Consider Resetting IA Config

The first page of the wizard enables us to select which group to use and assign a name. On a DigiOne-IAP you'll likely only have one group. An example where you could have 2 groups: you have a Modbus PLC on port #1 and DF1 PLC on port #2 and do simple protocol bridging to each as-if this DigiOne-IAP were 2 single-port units with 1 IP address

If you have any doubts about what is configured in the DigiOne-IAP, check box to **Reset all Industrial Automation Settings**. This will reset all settings and all groups. This is important since the wizard won't allow you to use a serial port that belongs to another configuration group. ***This reset frees up all IA resources.***

If you don't know what non-IA settings may be there, I encourage you to instead do a full reset – on the DigiOne-IAP home page you'll see the Factory Default Settings under Administration. This reset is important because some of the non-IA settings affect IA protocol behavior. This is wonderful if you need special behavior, but can be disastrous if you don't expect any special behavior!

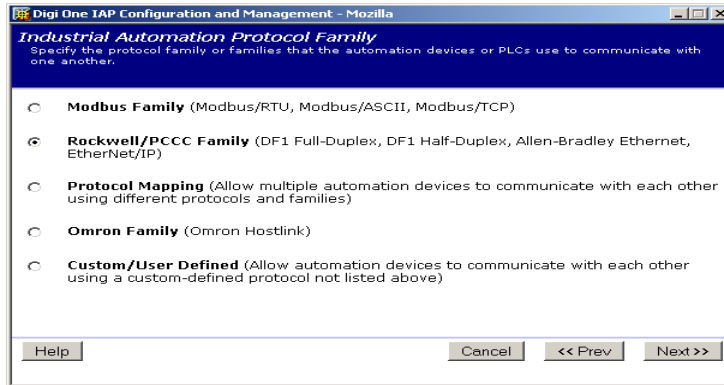
Since the **table1** group always exists, you can select to modify that group or define your own new name such as **df1_grp**.

The screenshot shows a web browser window titled "Digi One IAP Configuration and Management - Mozilla". The page is titled "Data Flow Group" and has the instruction "Specify a new or existing table to configure the Industrial Automation settings." There are two radio button options: "Create new configuration using new data flow group" (selected) and "Modify an existing configuration using existing data flow group". Under the first option, there is a text input field for "Table:" containing "df1_grp" and a checked checkbox for "Reset all Industrial Automation settings to factory defaults". Under the second option, there is a dropdown menu for "Table:" showing "table1". At the bottom of the form are buttons for "Help", "Cancel", "<< Prev", and "Next >>".



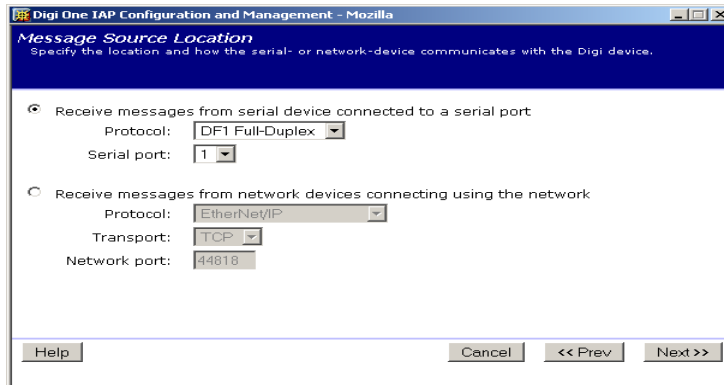
4.3. Limit the Group to PCCC Family

Since we'll only be using Rockwell protocols, we want to limit this group to only offering Rockwell options. Click next and we'll start defining where messages come from.

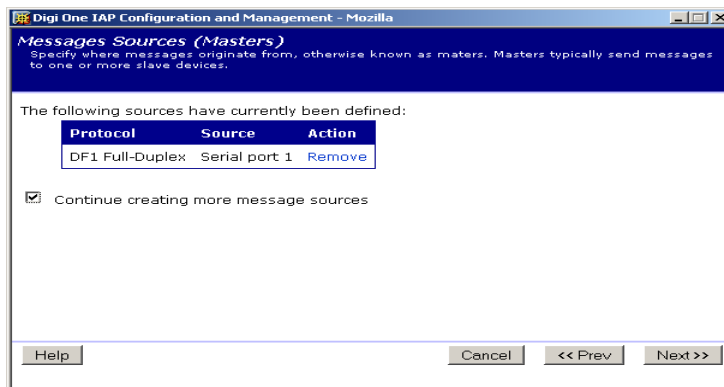


4.4. Define first Master / Message Source – the HMI

Our HMI is on serial port #1. Click **Next** and set the appropriate value in the following screens. Press **Help** if you need more explanation.



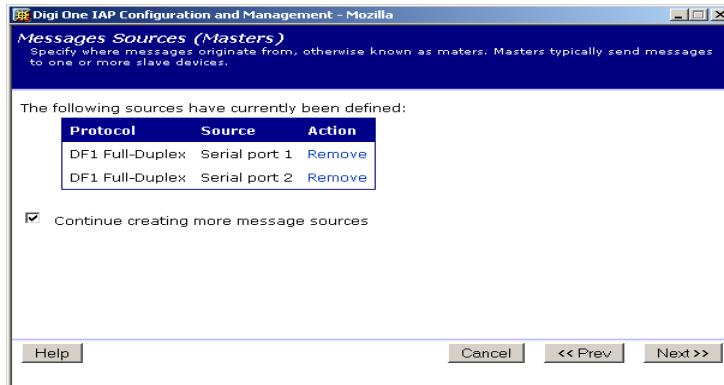
When you get to this page, click the **Continue creating ...** option so we can define our incoming Ethernet Master or message sources & press **Next**.





4.5. Define second Master / Message Source – the PLC

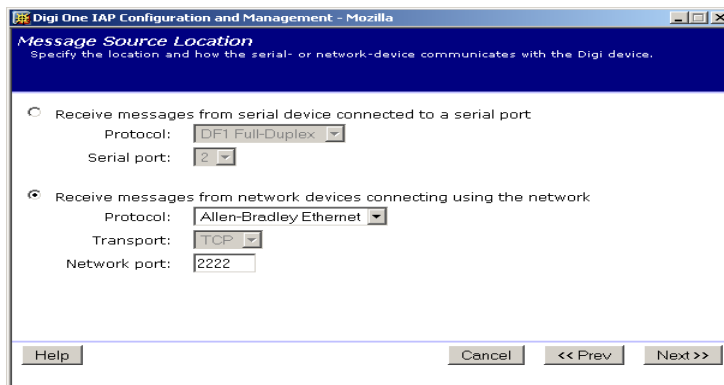
Although this is NOT required, we can enable the PLC to issue MSG blocks. Basically go through the same steps as above for Serial Port 2. Because of the way DF1 Full-Duplex works as a peer-to-peer protocol, this will NOT interfere with using the PLC like a slave device.



4.6. Define third Master / Message Source – remote PLC & RSLinx

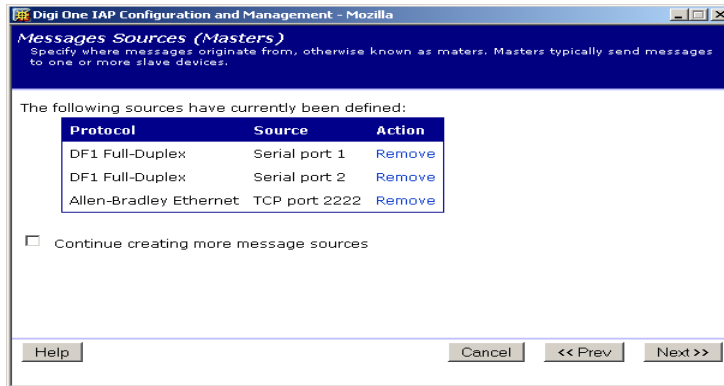
Click the option for network devices and set the protocol to Allen-Bradley Ethernet (or CSP). The Network Port should set itself to 2222. RSLinx cannot use Ethernet/IP to talk to your PLC because RSLinx doesn't recognize the DigiOne-IAP as a Rockwell product. However, you CAN loop an create a 3rd Master if you also want Ethernet/IP active for incoming ControlLogix messages.

But for RSLinx we want AB/Ethernet. Click **Next** and set the appropriate value in the following screens. Press **Help** if you need more explanation.





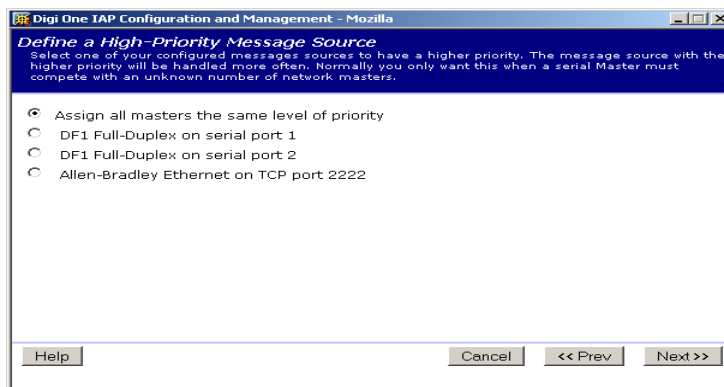
When you get to this page, *uncheck* the **Continue creating ...** option to stop adding Masters or message sources & press **Next**.



4.7. Assign Master Priority

As the text in the blue heading says, this option allows a serial Master to compete with many network Masters. A simple example – suppose you have 49 network Masters and 1 serial Master connected. The normal priority design will give each master fair, round-robin access to the shared slave. So if all are active and polling, the serial master obtains just 2% of the serial bandwidth, which at 9600 baud likely means 1 message every 10 seconds! By setting priority on the serial Master, you give it roughly 50% of the serial bandwidth and force all network Masters to compete for the remaining 50%.

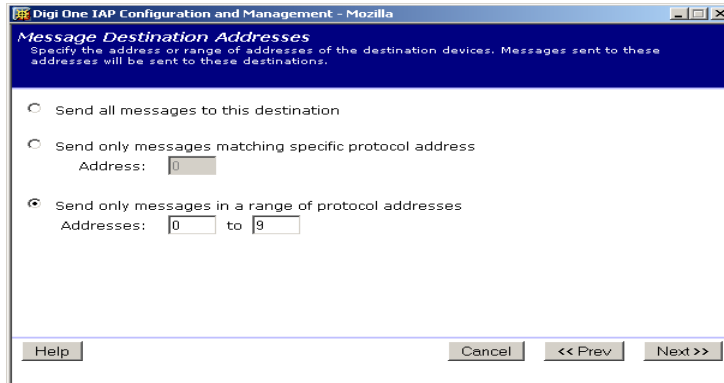
For Rockwell protocols and products, leaving them all at same priority should be fine. The only situation where changing this would matter is if some 3rd party ActiveX or OPC opens multiple sockets to attempt faster access – for example a single client opening 10 sockets to ask 10 polls in parallel would unfairly get 9 times more access than a 2nd client who politely asks 10 polls over 1 socket.



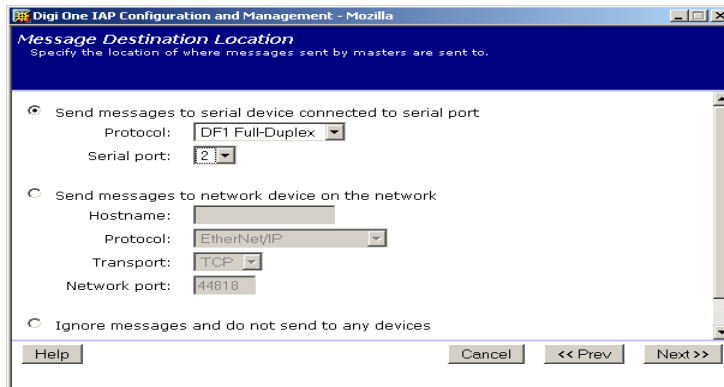


4.8. Create the first destination – the PLC

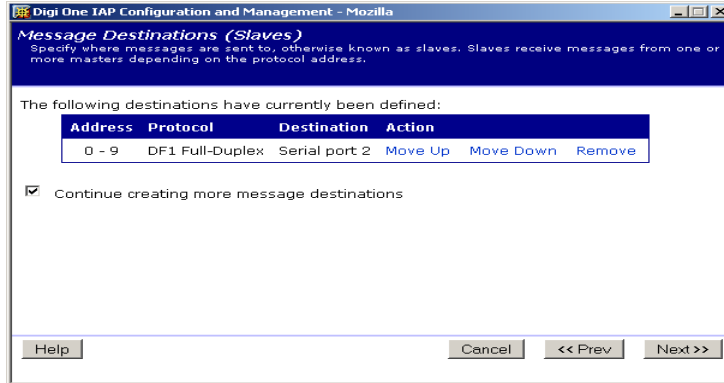
One very major change in Release E is that all Master – not just serial Masters – have the option to forward messages based on a protocol address. For DF1 this is the DST byte, while in AB/Ethernet or Ethernet/IP this is the DH+ Destination Link or Node address. We'll send all messages addressed from 0 to 9 to the PLC, which really is likely acting as DST=1. This makes RSLinx easier to setup since it is often difficult to understand how RSLinx sets these addresses!



Click the option for **serial devices**, set the **Protocol** to DF1 Full-Duplex and the **Serial Port** to 2. As before, go through the following pages and set values as desired – press Help if you need more information.

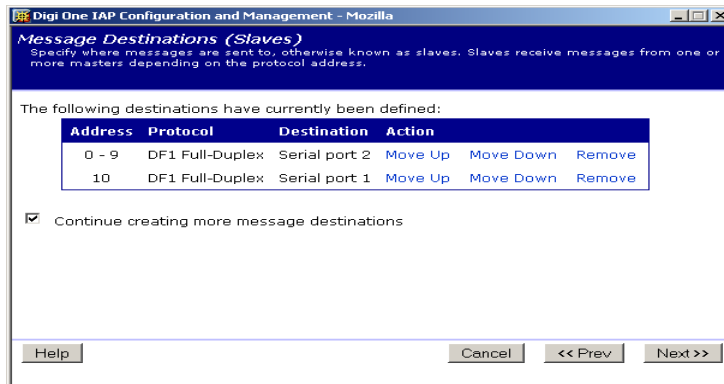


When you reach this page, check the box to Continue creating. We really could be done, but the Release E firmware allows any DF1 Full-Duplex device to be both Master and Slave. So we can add more destinations to allow the PLC to issue MSG blocks to other PLC.



4.9. Create the second destination – the HMI

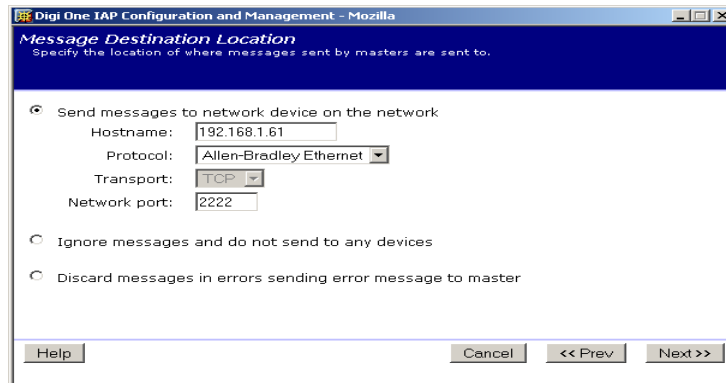
Following the same method as above, we can define node 10 as the HMI. This allows the PLC to use MSG blocks to read or write the HMI – if that has any value. It also allows remote Rockwell network Masters to access the HMI as DST or node or link 10. However you'll find RSLinx does NOT like the idea of more than 1 slave or device at an IP address of a non-Rockwell product.





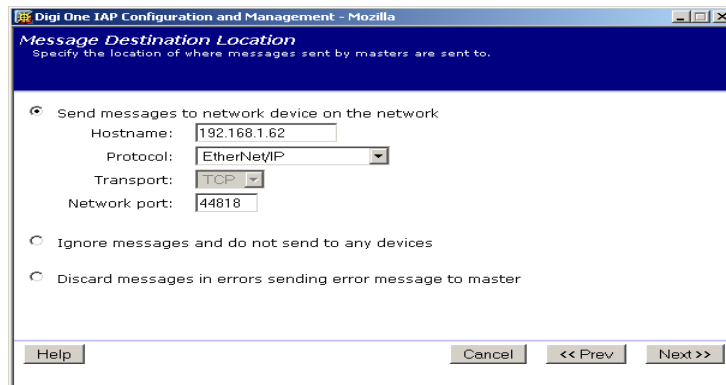
4.10. Create more destinations – remote DigiOne-IAP, PLC5 or SLC5/05

Now for a more value new feature in release E – since we allow the PLC “slave” to issue MSG blocks we can aim them at remote PLC. Continue creating destinations and select an address of 11. Notice the “Serial” destination option no longer shows up – the Wizard has no more serial ports to offer you! You can enter either an IP or DNS name. AB/Ethernet is our suggested protocol to access Rockwell PLC that support it – such as the PLC5E or SLC5/05.



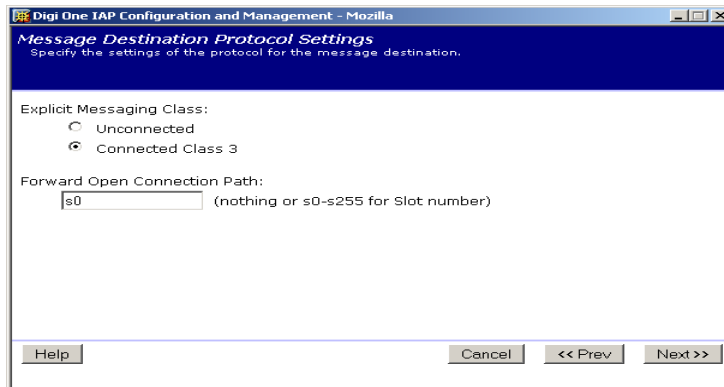
4.11. Create more destinations – remote ControlLogix

Release E also includes new features to interact with ControlLogix. To illustrate, we’ll set up a remote destination as a ControlLogix. We are still in the Continue Creating destination loop, so we won’t repeat showing all the screens. The Ethernet/IP protocol normally uses Network port 44818.



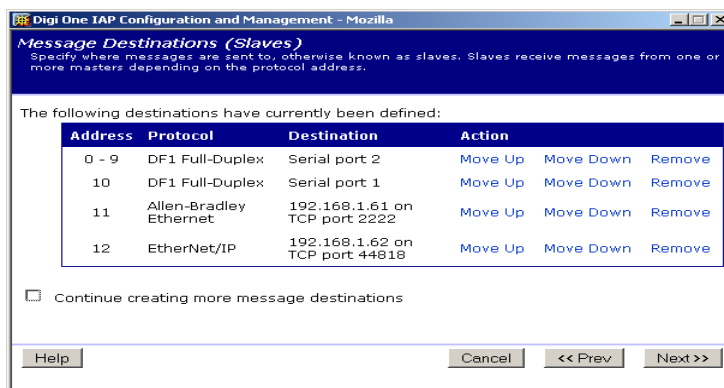


Unlike similar products from you-know-who, DigiOne-IAP gives you control of the outgoing connection. You can select connected (CM) or unconnected (UCMM) messaging – connected is safer with ControlLogix since it has allocates very limited resources for handling UCMM. You'll also need to define the slot number for the Logix processor. "s0" is common, but DigiOne-IAP allows addressing other slots or even multiple processors in a rack. If the remote Ethernet/IP server is another DigiOne-IAP, you can use this slot number to define an explicit DST or node value. So "S12" on a DigiOne-IAP to a DF1 serial slave would cause the DST byte to be set to 12.



4.12. The finished destinations table

Below is the finished destination table. Of course you could continue to add destinations. The DigiOne-IAP can manage up to 64 incoming and outgoing connections, so you could easily have 25 or even 60 remote destinations. Note that the DigiOne-IAP scans this table from top to bottom, stopping at the first route to match the address. This means if you'd change the first route from 0-9 to be 0-20, routes 2-4 would never be seen. You can use the **Move Up** and **Move Down** links to shuffle the table order.



4.13. Reboot the DigiOne-IAP

You can make minor changes to the DigiOne-IAP configuration. However, when changing the number or type of Masters (message sources) or number or type of Slave (message destinations) it is safest to reboot. This is because these



changes affect the number and type of tasks running in the DigiOne-IAP RTOS and occasionally these changes will fail to take effect correctly without a reboot.

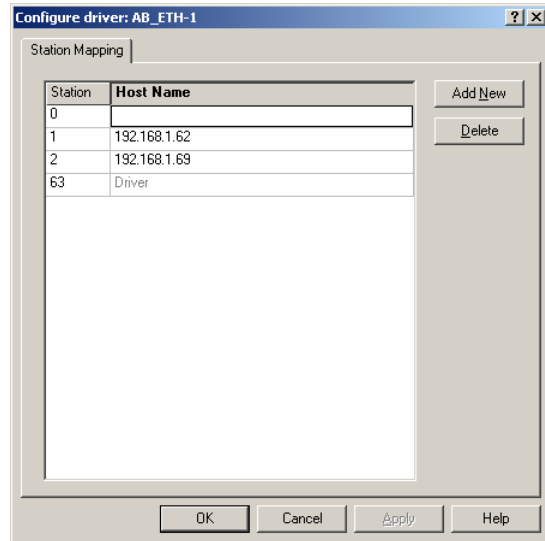
4.14. A note on RSLinx Setup

When you setup RSLinx, you should select the “**Ethernet Devices**” communication drive – *NOT* the “Ethernet/IP driver”.

When you setup the table, you see this dialog. Notice the “Station” column – this is an important field. RSLinx will use this as the DH+ destination node address within the AB/Ethernet (CSP) packet header. The DigiOne-IAP will use this as-if it were the DF1 DST byte.

So messages will follow the Destination table settings per this value. In the example illustrated in the application guide we had the PLC setup as slave address 0-9 – hopefully now you know why! This allows you to enter the DigiOne-IAP’s IP address in any of the station slots from 0 to 9. If you enter it in station rows 10 to 63, the DigiOne-IAP will NOT work as setup in this application guide!

Of course you can compensate for any RSLinx setting required. Suppose you must setup the DigiOne-IAP’s IP address in the station=57 row. Then all you need to do is make sure an entry exists within the DigiOne-IAP’s Destination Table forwarding PCCC messaged for slave address=57 to the PLC. Note that the PLC will actually see the DF1 DST byte = 57, but by default AB PLC ignore the DST byte in DF1 Full-Duplex messages.





5. Hyperterminal Setup (firmware E only shown)

You can use HyperTerminal or telnet to configure the DigiOne-IAP in firmware D1. However, we only document the script to do this for firmware E.

5.1. Copy this script and paste into NotePad

Acrobat will allow you to select and copy the text below and paste it into a text editor like NotePad.exe. Edit it as you require – you can also save it as documentation. Note that this script clears ALL industrial protocol settings when it starts, but it will not affect the IP address or other non-IA settings.

```
# clear all IA config
revert ia=factory

# setup port 1 (screw term) as DF1 (baud = 19200,8,N,1)
set port ra=1 dev=ia
set line ra=1 baud=19200 csize=8 parity=N stopb=1
set ia serial=1 protocol=df1fd type=master table=1

# setup port 2 (db9) as DF1 (baud = 19200,8,N,1)
set port ra=2 dev=ia
set line ra=2 baud=19200 csize=8 parity=N stopb=1
set ia serial=2 protocol=df1fd type=master table=1

# setup network for AB/Ethernet (CSP) incoming
set ia master=1 active=on protocol=abetherenet transport=tcp ipport=2222
table=1

# setup destination table
set ia table=1 name=table1

# port #1 is our HMI/Master - claim is address DST 10
set ia table=1 addroute=1 active=on protocol=df1fd
set ia table=1 route=1 protaddr=10 type=serial port=1
# port #2 is our PLC - claim is address DST 1 (0-9)
set ia table=1 addroute=2 active=on protocol= df1fd
set ia table=1 route=2 protaddr=0-9 type=serial port=2
```

5.2. Copy/Paste from NotePad to Hyperterminal

Use HyperTerminal or telnet to log into your DigiOne-IAP. You'll need to enter the IP address of your DigiOne-IAP and use the telnet port of 23.

In HyperTerminal use the "Edit | Paste to Host" menu option. You should not see any errors. You can use the "show ia all" command to verify the settings.

5.3. Reboot the DigiOne-IAP

You can make minor changes to the DigiOne-IAP configuration. However, when changing the number or type of Masters (message sources) or number or type of Slave (message destinations) it is safest to reboot. This is because these changes affect the number and type of tasks running in the DigiOne-IAP RTOS and occasionally these changes will fail to take effect correctly without a reboot.



5.4. Getting Fancy ... MSG blocks to remote PLC

Here's a freebie for observant readers. Add this 3rd & 4th route to your table to enable use of outgoing MSG blocks to remote nodes 11 and 12. *Note you'll need to change the IP addresses defined.* The DigiOne-IAP supports up to 64 in/outgoing TCP sockets, so you should be able to connect to about 60 remote devices.

```
# setup remote Ab/Ethernet slaves such as DigiOne-IAP, PLC5E, or SLC5/05
set ia table=1 addroute=3 active=on protocol=abethernet
set ia table=1 route=3 protaddr=11 type=ip ipport=2222
set ia table=1 route=3 connect=active ipaddress=192.168.1.63
set ia table=1 addroute=4 active=on protocol= abethernet
set ia table=1 route=4 protaddr=12 type=ip ipport=2222
set ia table=1 route=4 connect=active ipaddress=192.168.1.64
```

6. Trouble Shooting Tips

6.1. Baud Rates

A-B HMIs and PLCs normally default to Full-Duplex, 19200 baud, and CRC. The exception is Control/Compact Logix which tend to default to BCC

6.2. DST Address

RSLinx using DF1 fill-duplex defaults to the PLC is DST=1. This is why we setup the route table that way. Even though we are calling the HMI as DST=10, it is doubtful you can get RSLinx to issue messages to it. However, 3rd party packages may allow this. The HMI must issue DF1 requests to DST=1 (or any number in the routed range) for this design to work.

6.3. RSLinx Notes

You should set up RSLinx to use the **Ethernet driver** – NOT the Ethernet/IP driver. This forces you to create a table of IP address. Note some versions of RSLinx use the table index (ie: station number) as the DST address. This is WHY we set the PLC up to DST=0-9. So the above setup won't work if you place the DigiOne-IAP's IP address as the 50th entry in this table.

However, you should also note that RSLinx gets confused if you enter the same address twice. So while it would be nice to create entries for both the HMI and PLC, Rslinx will only show the one of them in an unpredictable manner. Using the "Alt-IP" feature in the DigiOne-IAP you CAN access both the HMI and PLC, but that is an advanced feature and presented in a second application note.

6.4. EDS Files

Talk to Rockwell and they may say the DigiOne-IAP needs an EDS file. Well, that not strictly true since the EDS file does NOT document handling of PCCC messages. However, you'll find EDS files for DigiOne-IAP firmware D1 and E at Digi's support web site. Search in the Knowledge base for the "Rockwell".