Using DNP3 with the NPort Series

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Applies to	NPort 5000 A: 5100A series, 5200A series, 5400A series, IA5250A
	NPort 5000: 5100 series, 5200 series, 5400 series, 5600 series, IA5150, IA5250
OS	Windows OS

In this application note, we will cover the following topics:

- 1. Introduction to DNP3 Networks
- 2. DNP3 Setup Using NPort UDP Mode
- 3. DNP3 Setup Using NPort TCP Server/Client Mode
- 4. DNP3 Communication Verification

Introduction to DNP3 Networks

DNP3 (Distributed Network Protocol) is a set of communications protocols used between components in process automation systems. It was developed for communications between various types of data acquisition and control equipment. It plays a crucial role in SCADA systems, where it is used by SCADA master stations (aka Control Centers), remote terminal units (RTUs), and intelligent electronic devices (IEDs). It is primarily used for

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About Moxa

Moxa manufactures one of the world's leading brands of device networking solutions. Products include serial boards, USB-to-serial hubs, media converters, device servers, embedded computers, Ethernet I/O servers, terminal servers, Modbus gateways, industrial switches, and Ethernet-to-fiber converters. Our products are key components of many networking applications, including industrial automation, manufacturing, POS, and medical treatment facilities.

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communications between a master station and RTUs or IEDs. ICCP, the Inter-Control Centre Protocol, is used for inter-master station communications.



This application note describes two proven methods for DNP3 communications using the NPort A series. In this case, these NPort servers can be located at remote locations, eliminating costly modem connections while providing real-time access to serial devices via Ethernet. In TCP server/client mode, we defined the DNP3 master as TCP server and DNP3 slave as TCP client. There are two serial applications with the DNP3 device. We used these two examples to demonstrate how to build a DNP3 network with the NPort server.

- 1. A network with one DNP3 master and multiple DNP3 slaves, using UDP mode or TCP server/client mode. TCP server/client mode supports a maximum of 4 slaves.
- 2. A network with one DNP3 master and one DNP3 slave, using UDP or TCP server/client mode.

User can setup the suitable application topology for DNP3 communication environment. Please refer to topic $2 \sim 4$ for setting configuration of NPort and verify it work properly.

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DNP3 – single-master to multi-slave environment



DNP3 single master to single slave environment

DNP3 Setup Using NPort UDP Mode

First, verify that the IP and serial interfaces of the NPort and DNP3 slaves are configured properly. In this case, NPort's IP as the DNP3 master is 192.168.1.1 and the IP addresses for DNP3 slaves should be 192.168.1.12~ 192.168.1.14. UDP mode can support single or multiple slaves in a DNP3 network.

Setting the NPort as the DNP3 master

1. Select UDP as the mode of operation, use the broadcast IP as the destination IP. For example, we used 192.168.1.255 as the destination IP when slave's IP are between 192.168.1.12 and 192.168.1.14.

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2. Because the default port for the DNP3 is 20000, we should change the UDP local port to 20000. This ensures that the master and slave can communicate with each other.

Operating Settings	
	Port=1
Operation mode	UDP Mode
	Data Packing
Packing length	0 (0 - 1024)
Delimiter 1	0 (Hex) Enable
Delimiter 2	0 (Hex) Enable
Delimiter process	Do Nothing Y (Processed only when Packing length is 0)
Force transmit	0 (0 - 65535 ms)
	UDP Mode
	Begin End Port
Destination IP address 1	192.168.1.255 : 20000
Destination IP address 2	: 4001
Destination IP address 3	: 4001
Destination IP address 4	: 4001
Local Listen port	20000
Apply the above settings to all s	erial ports (Local listen port will be enumerated automatically).
	Submit

Setting the NPort as the DNP3 Slave

Operating Settings

- 1. Select UDP as the mode of operation, and enter the IP address of the DNP3 master as the destination IP address.
- 2. Because the default port for the DNP3 is 20000, we should change the UDP local port to 20000. This ensures that the master and slave can communicate with each other.

operating settings	
	Port=1
Operation mode	UDP Mode
	Data Packing
Packing length	0 (0 - 1024)
Delimiter 1	0 (Hex) Enable
Delimiter 2	0 (Hex) Enable
Delimiter process	Do Nothing 🔽 (Processed only when Packing length is 0)
Force transmit	0 (0 - 65535 ms)
	UDP Mode
	Begin End Port
Destination IP address 1	192.168.1.1 : 20000
Destination IP address 2	: 4001
Destination IP address 3	: 4001
Destination IP address 4	: 4001
Local Listen port	20000
Apply the above settings to all s	erial ports (Local listen port will be enumerated automatically).
	Submit

DNP3 setup using NPort TCP server/client mode

First, verify that the IP and serial interfaces of the NPort and DNP3 slaves are configured properly. In this case, NPort's IP as the DNP3 master is 192.168.1.1 and the IP addresses for DNP3 slaves should all be 192.168.1.14. TCP server/client mode can support either single-master to single-slave topology, or single-master to multiple-slaves (max. 4 slaves) topologies in a DNP3 network.

Settings the NPort as the DNP3 master

- 1. Select TCP server mode and the NPort (DNP3) master will wait for slaves (max. 4 slaves) to connect.
- Because the default port for the DNP3 is 20000, we should change the TCP local port to 20000. This ensures that the master and slave can communicate with each other.
 Operating Settings

	Port 1
Operation mode	TCP Server Mode
TCP alive check time	7_(0 - 99 min)
Inactivity time	0 (0 - 65535 ms)
Max connection	1 •
Ignore jammed IP	● No ○ Yes
Allow driver control	● No ○ Yes
	Data Packing
Packing length	0 (0 - 1024)
Delimiter 1	0 (Hex) Enable
Delimiter 2	0 (Hex) Enable
Delimiter process	Do Nothing 💽 (Processed only when Packing length is O
Force transmit	0 (0 - 65535 ms)
	TCP Server Mode
Local TCP port	20000
Command port	966
	Submit

Settings the NPort as the DNP3 slave

- 1. Select TCP client mode and enter the DNP3 master IP address as the destination IP address. For this example, we set the destination IP to 192.168.1.1, same as the DNP master IP address.
- 2. Because the default port for the DNP3 is 20000, we should change the TCP local port to 20000. This ensures that the master and slave can communicate with each other.

	Port 1		
Operation mode	TCP Client Mode		
TCP alive check time	7 (0 - 99 min)		
Inactivity time	0 (0 - 65535 ms)		
Ignore jammed IP	⊙No OYes		
	Data Packing		
Packing length	0 (0 - 1024)		
Delimiter 1	0 (Hex) Enable		
Delimiter 2	0 (Hex) Enable		
Delimiter process	Do Nothing 💉 (Processed only when Packi	ing lengti	h is O)
Force transmit	0 (0 - 65535 ms)		
	TCP Client Mode		
	Destination IP Address		
Destination IP address 1	192.168.1.1	: 20000	
Destination IP address 2		: 4001	
Destination IP address 3		: 4001	
Destination IP address 4		: 4001	
Designated Local Port 1	20000 (0 - 65535, 0 represents assigned a	automati	cally.)
Designated Local Port 2	5012 (0 - 65535)		
		-	

DNP3 Communication Verification

After the DNP3 network has been set up, user can now verify the DNP3 communication by using the following steps. User can simulate DNP3 requests and responses via this tool to check DNP3 communication.

- 1. Install the "Protocol Test Harness" application and open it.
- 2. Select Open->Master Session ->DNP3

fr t	riangle MicroWorks	, Inc. Protoco	l Test Harness		
File	Open Edit Window	Help			
🚔	Conformance Test	· 🛉 🗸 🔶			
1	Master Session Slave Session Monitor Channel Data Window Command Window Statistics Window	 DNP3 MODBUS IEC 60870-5 IEC 60870-5 IEC 60870-5 IEC 60870-5 IEC 60870-5 IEC 60870-5 	-101 sport -102 nk -103 jl -104	Database Header: 🔽 Static 🔽 Event 🔽 Cyclic 🔽 Security Data: 🗂 Static 🗂 Event 🔽 Cyclic 🔽 Security	Clear Display Pause Display AutoScrolling Max/Pos Visible Lines: 1225/8660

3. Right click 'mDNP', select 'Modify Session' to input DNP3 master settings.

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4. Select the 'Channel' tab and set serial/TCP parameters

🔜 Open DNP3 Master	
Channel Session Next Step	
Channel Name mDNP	_
Connection Type	
Serial C TCP/IP	
Serial Port	
Serial Port COM1 -	
Baud Rate 9600	

5. Select the 'Session' tab to set link layer address

ssion Name	mDNP		
Link Layer Ad	dresses —		
Source:	1	-	
Destination:	2	-	

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6. Select Open->Master Session ->DNP3 to create DNP slave

fi t	riangle MicroWorks	, Inc. Protocol Test I	Harness		
File	Open Edit Window	Help			
🚄 İ	Conformance Test 🕨	• 🗣 🖌 ?	_		
	Master Session Slave Session Monitor Channel Data Window Command Window Statistics Window	 DNP3 MODBUS IEC 60870-5-101 IEC 60870-5-102 IEC 60870-5-103 IEC 60870-5-104 	sport nk il	Database Header: 🔽 Static 🔽 Event 🔽 Cyclic 🔽 Security Data: 🔽 Static 🔲 Event 🔽 Cyclic 🔽 Security	Clear Display Pause Display AutoScrolling Max/Pos Visible Lines: 1225/8660

7. Right click 'mDNP' and select 'Modify Session' to input DNP3 slave settings



8. Select the 'Channel' tab and set serial/TCP parameters

mouny DNP 5 Stave	
Channel Session Next Step	
Channel Name SDNP	
Connection Type Serial C TCP/IP	
Serial Port	
Serial Port COM1 -	

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9. Choose 'Session' to set link layer address

ession Name	IMDINE		
Link Layer Ad	dresses		
Source:	1	÷	
Destination:	2	÷	
Unsolicited Re	port by Excer	otion	

10. On the DNP3 Commands window

11. Click 'Integrity Data Poll – Class 0123'



12. Set repeat interval to 1 second

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13. Click 'Start repeat' to start testing

🌠 Integrity Poll Configuration				
		_		
Name:	Integrity Data Poll - Class 0123	_		
Target:	Use Command Window target selection	▲ ▼		
Description Select target or allow this command to follow Command V The Integrity Poll retrieves all Each target is shown as "ChannelName:SessionName:Ses				
device. It is typically sent after device restart, loss of communication, or on a periodic basis to ensure all data is accurate.				
Command options				
🗖 Class 0 Only				
-Equivalent To	cl command line arguments			
mdnpintegrity session 0				
•				
Copy to Clipboard				
Repeat Interval				
	Once			

14. On Statistics window, we can see both the "Requests Sent" and "Responses Received" counts are increasing.

# Statistics - MDNP.mDNP		
Action Target		
	Responses Received	4551
	Requests Failed	0
Requests Sent 4565	Requests Timed Out	0
	Channel Errors	0

15. Under normal operation, "Requests Failed", "Requests Time Out", and "Channel Errors" should not have values. If errors are displayed, recheck the configurations.

We used the utility called "Protocol Test Harness" to simulate the DNP3 network. If you would like to use this utility, it can be found here:

http://www.trianglemicroworks.com/DownloadTestHarnessRequest.aspx