DNP3 Protocol Master Client Simulator

User Manual

Stack Version: 21.05.008

DNP3 Protocol



FreyrSCADA Embedded Solution

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<u>Download Free Demo Evaluation Kit – DNP3</u> <u>Development Bundle</u>

New updated Version of DNP3 Simulator & SDK (Software Development Kit) is available now. In the Development Bundle, We included DNP3 Server & Client Simulator, Windows and Linux SDK, C# projects, Doxygen documentation and Raspberry Pi, BeagleBone Demo library.

Introduction

DNP3 was first developed by Westronic and was released in 1993. This protocol is widely used among the electric, oil and gas, and wastewater/water utilities.

It is preferred among the electric utilities. All these characteristics that are highly-valued among electric utilities and the oil and gas industry with widely remote field stations.

DNP3 was based upon the early drafts of IEC 60870-5. DNP3 was extended in 1998 to be encapsulated in either a TCP or UDP packet (TCP is typically used).

FreyrSCADA DNP3 (IEEE 1815) – Outstation (Server) Simulator was originally developed to test the DNP3(IEEE 1815) stack.

Freyr SCADA DNP3 (IEEE 1815) – Master (Client) Simulator was originally developed to test the DNP3(IEEE 1815) stack.

We developed the stack to run multiple hardware platform (windows, linux, RTLinux, qnx..). So we had to test multiple platform. At that time, our engineers, developed the test simulation application.

We tested this simulator with multiple test software available in the market.

The interoperability list focused only for our Stack. If you have any specific requirement to implement new Data type, please contact us.

Our support team has young, dynamic and professional team of engineers. And they will provide the quick and accurate solution as per customer requirement.

support@freyrscada.com

Thanks

Management- FreyrSCADA Embedded Solution

Add and Delete Client

We can add up to 50 Client node in the simulator. Every Client node will work independently.

And also we can delete the Client.

FreyrSCADA DNP3 Client Simu	lator - Untitl	ed						e ø 💌
Main Help								
Add Client Delete Client	t					23/02/2017 12:54	:47	FULL_VERSIO
<mark>⊟-</mark> Simulator	Simulator	DNP3_CLIENT_1	Configuration_1	Data_Objects_1	Traffic_1 Log_1 DNP3_CLIEN	T_2 Configuration_2 Da	ata_Objects_2 Traffi	c_2 Log_2
DNP3_CLIENT_1	Simulator							
Configuration_1	Total C	lient Count	2					
Data_Objects_2	S.No	C	Client Name	Status	Communication mode	Serial Com Port Number	Server IP address	Port Number
Log_2	1	[DNP3_CLIENT_1	Running	TCP_IP_MODE	1	127.0.0.1	20000
	2	C	DNP3_CLIENT_2	Running	UDP_IP_MODE	1	127.0.0.1	20000
						1	1	

Simulator window shows the status & connected Communication channel

TCP – IP Address, Port Number

UDP - IP Address, Port Number

Serial – Com Port Number

Total Client Count2Client NameStatusCommunication modeSerial Com Port NumberDNP3_CLIENT_1RunningTCP_IP_MODE1127.0.0.12000	Total Client Count2Client NameStatusCommunication modeSerial Com Port NumberServer IP addressPort NumberDNP3_CLIENT_1RunningTCP_IP_MODE1127.0.0.12000DNP3_CLIENT_2RunningUDP_IP_MODE1127.0.0.12000	Total Client Count2Client NameStatusCommunication modeSerial Com Port NumberServer IP addressPort NumberDNP3_CLIENT_1RunningTCP_IP_MODE1127.0.0.12000DNP3_CLIENT_2RunningUDP_IP_MODE1127.0.0.12000	mulator					
Client Name Status Communication mode Serial Com Port Number Server IP address Port Number DNP3_CLIENT_1 Running TCP_IP_MODE 1 127.0.0.1 20000	Client NameStatusCommunication modeSerial Com Port NumberServer IP addressPort NumberDNP3_CLIENT_1RunningTCP_IP_MODE1127.0.0.120000DNP3_CLIENT_2RunningUDP_IP_MODE1127.0.0.120000	Client NameStatusCommunication modeSerial Com Port NumberServer IP addressPort NumberDNP3_CLIENT_1RunningTCP_IP_MODE1127.0.0.120000DNP3_CLIENT_2RunningUDP_IP_MODE1127.0.0.120000	Total Client Count	2				
DNP3_CLIENT_1 Running TCP_IP_MODE 1 127.0.0.1 20000	DNP3_CLIENT_1 Running TCP_IP_MODE 1 127.0.0.1 20000 DNP3_CLIENT_2 Running UDP_IP_MODE 1 127.0.0.1 20000	DNP3_CLIENT_1 Running TCP_IP_MODE 1 127.0.0.1 20000 DNP3_CLIENT_2 Running UDP_IP_MODE 1 127.0.0.1 20000	Client Name	Status	Communication mode	Serial Com Port Number	Server IP address	Port Number
	DNP3_CLIENT_2 Running UDP_IP_MODE 1 127.0.0.1 20000	DNP3_CLIENT_2 Running UDP_IP_MODE 1 127.0.0.1 20000	DNP3_CLIENT_1	Running	TCP_IP_MODE	1	127.0.0.1	20000
DNP3_CLIENT_2 Running UDP_IP_MODE 1 127.0.0.1 20000			DNP3_CLIENT_2	Running	UDP_IP_MODE	1	127.0.0.1	20000
			•					

Client Configuration

Client Protocol Configuration window shows the actual protocol settings.

FreyrSCADA DNP3 Client Sin	nulator - Untitled		
iin Help			
Add Client Delete Clie	ent	23/02/2017	12:57:24
Simulator	Simulator DNP3_CLIENT_1 Configuration_1 Da	ta_Objects_1 Traffic_1 Log_1 DNP3_CLIENT_2 Configuration_	2 Data_Objects_2 Traffic_2 Log_2
DNP3_CLIENT_1	DNP3 CLIENT 1		
Configuration_1		D. T.R. AVI	
Traffic 1	Item		
Log_1			
DNP3_CLIENT_2	Serial Port Number	1	_
Configuration_2	Baud Rate	BITRATE_9600	_
Data_Objects_2	Word Length	WORDLEN_8BITS	_
	Stop Bits	STOPBIT_1BIT	
LUY_2	Parity	EVEN	
	Flow Control	FLOW_NONE	
	Inter Message Delay	0	
	Transmit PreDelay	0	
	Transmit PostDelay	0	
	Transmit Inter Character Delay	0	
	Transmit Character Timeout	0	
	Transmit Character Retries	0	
	Transmit Message Timeout	0	
	Transmit Message Retries	0	
	Receive PreDelay	0	
	Receive PostDelay	0	
	Receive Inter Character Delay	0	
	Receive Character Timeout	0	
	Receive Character Retries	0	
	Receive Message Timeout	0	
	Receive Message Patries	0	
	Receive riessage Retries	U	Communication Mode serial

Configuration Parameters as follows:

- 1) Communication Mode Communication Mode serial /TCP_IP/UDP
- 2) Serial Port Number Serial COM port number
- 3) Baud Rate Serial Bit/Baud Rate
- 4) Word Length Serial Word Length
- 5) Stop Bits Serial Stop Bits
- 6) Parity Serial Parity
- 7) Flow Control Flow Control
- 8) Inter Message Delay Time between sending and receiving of message only applies after transmitting the message
- 9) Transmit PreDelay Transmit Delay before send
- 10) Transmit PostDelay Delay after send
- 11) Transmit Inter Character Delay Delay between characters during send
- 12) Transmit Character Timeout Timeout if the character is not being sent
- 13) Transmit Character Retries Number of retries to send

- 14) Transmit Message Timeout Message Timeout if entire message is not sent
- 15) Transmit Message Retries Transmit Message Retries to retry the entire message
- 16) Receive PreDelay Delay before receive
- 17) Receive PostDelay Delay after receive
- 18) Receive Inter Character Delay Delay between characters during receive
- 19) Receive Character Timeout Timeout if the character is not being received
- 20) Receive Character Retries Number of retries to receive a character
- 21) Receive Message Timeout Message Timeout if entire message is not received
- 22) Receive Message Retries Receive Message Retries to retry the entire message
- 23) TCP Source IP Address TCP, Client, ip address to bind the socket
- 24) TCP Port Number TCP, Client, port to bind the socket
- 25) UDP Source IP Address UDP, Client, ip address to bind the socket
- 26) UDP Port Number UDP, Client, port to bind the socket
- 27) Master Address Expected Master / Client address range 0 to 65519
- 28) Outstation / Slave Address ClSlave/Outstation address range 0 to 65519
- 29) Link Layer Timeout Link layer time out in milliSeconds (minimum 1000ms to max)
- 30) Application Layer Timeout application layer timeout in millisecond 5 * Linklayer timeout
- 31) Poll Interval class 1,2,3 CLASS 123 poll interval in milliSeconds (minimum 1000ms to 2,147,483,000ms)
- 32) Integratity Poll Interval class 0,1,2,3 CLASS 0123 poll interval in milliSeconds (minimum 1000ms to 2,147,483,000ms)
- 33) Poll Interval class 0 CLASS 0 poll interval in milliSeconds (minimum 1000ms to 2,147,483,000ms
- 34) Poll Interval class 1 CLASS 1 poll interval in milliSeconds (minimum 1000ms to 2,147,483,000ms
- 35) Poll Interval class 2 CLASS 2 poll interval in milliSeconds (minimum 1000ms to 2,147,483,000ms
- 36) Poll Interval class 3 CLASS 3 poll interval in milliSeconds (minimum 1000ms to 2,147,483,000ms
- 37) Enable UTC time enable utc time/ local time
- 38) Unsolicited Enable Responses on Startup enable to Client send unsolicited message on statup
- 39) Enable Frozen Analog Input Support False- stack will not create points for frozen analog input
- 40) Enable FileTransfer Enable File Transfr Support
- 41) FileOperation Timeout file read/write timout in milliseconds, minimum 10000 ms
- 42) Call Update Callback even Timestamp changes if it true , the timestamp change also create the updatecallback
- 43) Command Timeout Command timout in milliseconds, minimum 3000ms

Client Data Configuration

Client Data Configuration window shows the point list configuration.

🗠 FreyrSCADA DNP3 Client Simulator - Untitled 📃 💼 🛃									
Main Help									
Add Client Delete Client 23/02/2017 13:07:12									
Simulator	Simulator DNP3_CLIENT_1 Configuration_1 Data_Objects_1 Traffic_1 Log_1 DNP3_CLIENT_2 Configuration_2 Data_Objects_2 Traffic_2 Log_2								
- DNP3_CLIENT_1	Configuration_1								
Data_Objects_1									
Traffic_1	Add Row Delete Row Load Configuration								
DNP3_CLIENT_2		1	1	1		1			
Configuration_2	S.No	DNP3 Group ID	Starting Index Number	Number of Points	Class	Control Model	SBO TimeOut	Analog Deadband Value	
Traffic_2	1	BINARY_INPUT	0	1	CLASS_ONE	STATUS_ONLY	0	0	
Log_2	2	BINARY_OUTPUT	0	1	CLASS_ONE	DIRECT_OPERATION	0	0	
	3	BINARY_INPUT -							
		DUBLE_INPUT BUNARY_OUTPUT COUNTER_INPUT ANALOG_OUTPUTS OCTECT_STRING VIRTUAL_TERMINAL_O						•	

DNP Group to choose

BINARY_INPUT - Binary Input (DNP3Group 1)

DOUBLE_INPUT - Double-bit Binary Input (DNP3Group 3)

BINARY_OUTPUT - Binary Output (DNP3Group 10)

COUNTER_INPUT - Counter Input (DNP3Group 20)

ANALOG_INPUT - Analog Input (DNP3Group 30)

ANALOG_OUTPUTS - Analog output (DNP3Group 40)

OCTECT_STRING - Octect String (DNP3Group 110)

VIRTUAL_TERMINAL_OUTPUT - virtual terminal String (DNP3Group 112)

Station Commands

In the Data object window, plain space, just right click , the station command window will open,

Data_O	bjects_1									
Start	Communication	Stop Co	mmunication							
5.No	DNP3 Group Id	Index Number	Value	COMM	1.007	-	12.20	lime Stamp	Class	
2		1	0	COMM		-	13:20	24 23/02/2017	CLASS_ONE	ST/
2		2	0	COMM	1.051		13.20	24 23/02/2017	CLASS_ONE	ST
4		3	0	сомм	1.051		13:20	24 23/02/2017	CLASS_ONE	ST
5		4	0	сомм	1.051	-	13:20	24 23/02/2017	CLASS_ONE	STA
6		0	0	сомм	LOST	-	13:20	:24 23/02/2017	CLASS ONE	DIR
7	BINARY OUTPUT	1	0	сомм	LOST		13:20	:24 23/02/2017	CLASS ONE	DIR
8	BINARY OUTPUT	2	0	СОММ	LOST	г Г	13:20	:24 23/02/2017	CLASS ONE	DIF
9	BINARY OUTPUT	3	0	СОММ	LOST	г Г	13:20	:24 23/02/2017	CLASS ONE	DIF
10	BINARY OUTPUT	4	1		-			24 23/02/2017	CLASS ONE	DIR
		Stati	on Commands	•		Read Scan Class Command				
		Poin	t Command			Freeze and Clear				
						Clock sync				
						Spontaneous Command				
						Special DNP3 Command				
•										
tation (Commands									E
Read Co	ommand									
Server	Address: 1									
Master	Address: 2									
Read	De	ad Class 0122	Fean w							
Read	Re	ad Class 0123								
	Re	ad Class 0 Sca ad Class 1 Sca								
	Re	ad Class 2 Sca	n							
	Re	ad Class 3 Sca	n							
	Re	ad Class 123 S	can							
	Re	ad Class 0123	Scan							
							Send F	Read Command	d	

The command window will show the result also, the send command success or fail.

Point Command

The individual command has point command.

Point Command Wir	ndow	
Single Command		
Group :	BINARY_OUTPUT	
Index :	2	
Operation type	LATCH_ON -	
Count	1	
On Time	0	
Off Time	0	
Command type	DIRECT_OPERATE -	
Value	0 🔺 0 - Open, 1 - Close	
		Send Single Command
Point Command Win	dow	

Just right click the command point in the data object window,

Point Command Window	N	× 1
Analog Output		
Group :	ANALOG QUITPUTS	
Index :	0	
Command type	DIRECT_OPERATE -	
Value	-123.456	
	(Send Analog ouput Command

Traffic window

In this we can monitor the traffic of DNP, TCP, UDP, Serial communication.

In this we can save the traffic, and clear the traffic

Traffic_1	
Clear Save	1
8/16/2016 8:17:32 AM Ethernet port ip 127.0.0.1 port 20000 receive 18 bytes : R <- 05 64 0b c4 01 00 02 00 69 9e d7 c7 01 3c 01 06 12 1f 8/16/2016 8:17:32 AM	*
Ethernet port ip 127.0.0.1 port 20000 Transmit 190 bytes : T -> 05 64 a5 44 02 00 01 00 f3 54 d7 c7 81 90 00 01 02 00 00 09 01 01 01 01 01 01 01 01 01 01 01 01 00 00	010101ad c101010
Ethernet port ip 127.0.0.1 port 20000 receive 27 bytes : R <- 05 64 14 c4 01 00 02 00 4a a2 d8 c8 01 3c 02 06 3c 03 06 3c 04 06 3c 01 06 d7 4f 8/16/2016 8: 17:33 AM	
Éthernet port ip 127.0.0.1 port 20000 Transmit 190 bytes : T -> 05 64 a5 44 02 00 01 00 f3 54 d8 c8 81 90 00 01 02 00 00 09 01 01 01 01 01 01 01 01 01 01 01 01 01	010101ad c101010
Éthernet port ip 127.0.0.1 port 20000 receive 18 bytes : R <- 05 64 0b c4 01 00 02 00 69 9e d9 c9 01 3c 01 06 4a 71 8/16/2016 8:17:33 AM	
Ethernet port ip 127.0.0.1 port 20000 Transmit 190 bytes : T -> 05 64 a5 44 02 00 01 00 f3 54 d9 c9 81 90 00 01 02 00 00 09 01 01 01 01 01 01 01 01 01 01 03 02 00 00 09 01 01 01 01 01 8/16/2016 8:17:33 AM	010101ad c101010:
Ethernet port ip 127.0.0.1 port 20000 receive 27 bytes : R <- 05 64 14 c4 01 00 02 00 4a a2 da ca 01 3c 02 06 3c 03 06 3c 04 06 3c 01 06 07 ee 8/16/2016 8: 17:33 AM	
Ethernet port ip 127.0.0.1 port 20000 Transmit 190 bytes : T -> 05 64 a5 44 02 00 01 00 f3 54 da ca 81 90 00 01 02 00 00 90 10 10 10 10 10 10 10 10 10 10 10 10 00 0	010101ad c101010
Ethernet port ip 127.0.0.1 port 20000 receive 18 bytes : R <- 05 64 0b c4 01 00 02 00 69 9e db cb 01 3c 01 06 f1 11 8/16/2016 8:17:33 AM	
Ethernet port ip 127.0.0.1 port 20000 Transmit 190 bytes : T -> 05 64 a5 44 02 00 01 00 f3 54 db cb 81 90 00 01 02 00 00 90 101 01 01 01 01 01 01 01 01 01 01 03 02 00 00 90 101 01 01 01 8/16/2016 8:17:33 AM	.010101ad c101010
Emeret port (p. 127.).0.1 port 20000 receive 27 bytes : K <- 05 64 14 c4 01 00 02 00 4a az dc cc 01 3c 02 06 3c 03 06 3c 04 06 3c 01 06 0e 41 8/16/2016 8:17:33 AM	
Ememet port ip 127.0.0.1 port 20000 fransmit 190 bytes : 1 -> 05 64 a5 94 02 00 01 05 54 dc cc 81 90 00 01 02 00 00 09 01 01 01 01 01 01 01 01 01 01 01 01 01	010101ad c101010:
	۴

Log Window

Log window for internal reference

Log_1	
Clear Save	1
8/16/2016 7:52:58 AM: DNP3 Server Node Created 8/16/2016 7:53:11 AM: DNP3 Server Node Configuration Loaded 8/16/2016 7:53:12 AM: DNP3 Server Started-Running 8/16/2016 8:14:21 AM: DNP3 Server Node Configuration Loaded 8/16/2016 8:14:30 AM: DNP3 Server Stoped 8/16/2016 8:14:30 AM: DNP3 Server Started-Running 8/16/2016 8:23:09 AM: cbOperate() called	*
GROUP ID : ANALOG_OUTPUT Index Number 6 data : 123.000000	
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	P

In the log, we can monitor the command exchange between Client & master, and there is an option to save the log & clear log.

For more information, just drop a mail to support@freyrscada.com