DNP3 Protocol Outstation RTU IED Server 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.

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 to 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 Server

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

And also we can delete the server.

FreyrSCADA DNP Server Simul	lator							
Main Help								
Add Server Delete Serv	16/08/2016 07	7:53:46						F
Simulator Add a new DNP Server	r Simulator DNP_SERVER_1	Configuration_1 Data	_Objects_1 Traffic_1 Log	1 DNP_SERVER_2 Col	nfiguration_2 Data_Object	s_2 Traffic_2 Log_2		
DNP_SERVER_1	Simulator							
Configuration_1	Simulation							
Traffic 1	Tatal Server Count	2						
	Total Server Count	2						
⊿ DNP_SERVER_2								
Configuration_2								
Data_Objects_2 Traffic_2	S.No	Server Name	Status	Communication mode	Serial Com Port Number	Server IP address	Port Number	
Log_2	1	DNP_SERVER_1	Running	TCP_IP	-	127.0.0.1	20000	
	2	DNP_SERVER_2	Running	Serial	1	-	-	

Simulator window shows the status & connected Communication channel

TCP – IP Address, Port Number

UDP – IP Address, Port Number

Serial – Com Port Number

S	imulator							
	Total Server Count	2						
	S.No	Server Name	Status	Communication mode	Serial Com Port Number	Server IP address	Port Number	
	1	DNP_SERVER_1	Running	TCP_IP	-	127.0.0.1	20000	
	2	DNP_SERVER_2	Running	Serial	1	-	-	
				,		,		

Server Configuration

Server Protocol Configuration window shows the actual protocol settings.

FreyrSCADA DNP Server Simul	ator		
Main Help			
Add Server Delete Serv	16/08/2016 07:56:57		FULL_VERSION
▲ · Simulator	Simulator DNP_SERVER_1 Configuration_1 Data	_Objects_1 Traffic_1 Log_1 DNP_SERVER_2 Configuration_2 Data_Objects_2 Traffic_	_2 Log_2
DNP_SERVER_1 Configuration_1	DNP_SERVER_1		
- Data_Objects_1	Item	Description & Value	▲ 1
Traffic_1	Communication Mode	TCP_IP_MODE Communication Mode serial /TCP_IP/UDP	
A DNP SERVER 2	Serial Port Number	1	
Configuration_2	Baud Rate	BITRATE_9600	
Data_Objects_2	Word Length	WORDLEN_8BITS	
Traffic_2	Stop Bits	STOPBIT_1BIT	
Log_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	Communication Mode serial /TCP_IP/UDP

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

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- 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, Server, ip address to bind the socket
- 24) TCP Port Number TCP, server, port to bind the socket
- 25) UDP Source IP Address UDP, Server, ip address to bind the socket
- 26) UDP Port Number UDP, server, port to bind the socket
- 27) **UDP -Server transmit Port Number Default** in udp , server transmit default port number 20000, or in which port data received , server will transmit same port
- 28) Outstation / Slave Address server/Slave/Outstation address range 0 to 65519
- 29) Master Address Expected Master / Client address range 0 to 65519 for unsolicited response
- 30) Link Layer Timeout Link layer time out in milliSeconds (minimum 1000ms to max)
- 31) Application Layer Timeout application layer timeout in millisecond 5 * Linklayer timeout
- 32) Time Sync Interval Seconds in Seconds, 0 to 3600s (1 hour)
- 33) Add BI in Class0 add Binary Input in class 0 request
- 34) Add DBI in Class0 add Double Binary Input in class 0 request
- 35) Add BO in Class0 add Binary Output in class 0 request
- 36) Add Cl in Class0 add Counter Input in class 0 request
- 37) Add FzCl in Class0 add Frozen Counter Input in class 0 request
- 38) Add AI in Class0 add Analog Input in class 0 request
- 39) Add FzAI in Class0 add Frozen Analog Input in class 0 request
- 40) Add AID in Class0 add Analog Input Deadband in class 0 request
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- 41) Add AO in Class0 add Analog Output in class 0 request
- 42) Add OS in Class0 add Octect String in class 0 request
- 43) Add BI Event add Binary Input Event in class 1,2,3 request
- 44) Add DBI Event add Double Bit Binary Input Event in class 1,2,3 request
- 45) Add BO Event add Binary Output Event in class 1,2,3 request
- 46) Add Cl Event add Counter Input Event in class 1,2,3 request
- 47) Add FzCI Event add Frozen Counter Input Event in class 1,2,3 request
- 48) Add Al Event add Analog Input Event in class 1,2,3 request
- 49) Add FzAI Event add Frozen Analog Input Event in class 1,2,3 request
- 50) Add AID Event add Analog Input Deadband Event in class 1,2,3 request
- 51) Add AO Event add Analog Output Event in class 1,2,3 request
- 52) Add OS Event add Octect String Event in class 1,2,3 request
- 53) Add VTO Event add Vitual termianal output Event in class 1,2,3 request
- 54) AI Deadband Method Analog Input Deadband Calculation method
- 55) Frozen Analog Input Support False- stack will not create points for frozen analog input
- 56) Eanble Unsolicited enable to server send unsolicited message
- 57) Unsolicited Enable Responses on Startup enable to server send unsolicited message on statup
- 58) **Unsolicited Response Timeout** timeout in milliseconds for unsolicites response from master minimum 1000 max app layer timeout
- 59) Unsolicited Retries Unsolicited message retries default 5, min 1, max 10
- 60) Unsolicited Max Number of Events each Unsolicited message contains max no of events minimum 1 -255
- 61) Unsolicited Class 1 Trigger Number of Events Class 1 Number of Class events to trigger the unsolicited response message , value should be < u16ClassEventBufferSize if it is 0, unsoltiated will not trigger from class event
- 62) Unsolicited Class 1 Hold Time After Response class 1 after send the class unsoldiated message Hold Time in ms,
- 63) Unsolicited Class 2 Trigger Number of Events Class 2 Number of Class events to trigger the unsolicited response message , value should be < u16ClassEventBufferSize if it is 0, unsoltiated will not trigger from class event
- 64) Unsolicited Class 2 Hold Time After Response class 2 after send the class unsoldiated message Hold Time in ms, "
- 65) Unsolicited Class 3 Trigger Number of Events Class 3 Number of Class events to trigger the unsolicited response message , value should be < u16ClassEventBufferSize if it is 0, unsoltiated will not trigger from class event
- 66) Unsolicited Class 3 Hold Time After Response class 3 after send the class unsoldiated message Hold Time in ms,

- 67) Class 1 buffer Size Class 1 EventBufferSize no of events to hold minimum 50
- 68) Class 1 buffer OverFlow Percentage Class 1 buffer overflow percentage 50 to 95
- 69) Class 2 buffer Size Class 2 EventBufferSize no of events to hold minimum 50
- 70) Class 2 buffer OverFlow Percentage Class 2 buffer overflow percentage 50 to 95
- 71) Class 3 buffer Size Class 3 EventBufferSize no of events to hold minimum 50
- 72) Class 3 buffer OverFlow Percentage Class 3 buffer overflow percentage 50 to 95
- 73) Default Static Variation BinaryInput Default Static Variation for Binary Input
- 74) Default Static Variation DoubleBit BinaryInput Default Static Variation for DoubleBit BinaryInput
- 75) Default Static Variation BinaryOutput Default Static Variation for Binary Output
- 76) Default Static Variation CounterInput Default Static Variation for Counter Input
- 77) Default Static Variation FrozenCounterInput Default Static Variation for Frozen Counter Input
- 78) Default Static Variation AnalogInput Default Static Variation for Analog Input
- 79) Default Static Variation FrozenAnalogInput Default Static Variation for Frozen Analog Input
- 80) Default Static Variation AnalogInputDeadBand Default Static Variation for Analog Input DeadBand
- 81) Default Static Variation AnalogOutput Default Static Variation for Analog Output
- 82) Default Event Variation BinaryInput Default Event Variation for Binary Input
- 83) Default Event Variation DoubleBit BinaryInput Default Event Variation for DoubleBit Binary Input
- 84) Default Event Variation CounterInput Default Event Variation for Counter Input
- 85) Default Event Variation AnalogInput Default Event Variation for Analog Input
- 86) Default Event Variation FrozenCounterInput Default Event Variation for Frozen Counter Input
- 87) Default Event Variation FrozenAnalogInput Default Event Variation Frozen Analog Input
- 88) Enable Self Address Support Enable Self Address Support
- 89) Enable UTC time enable utc time/ local time
- 90) Enable FileTransfer Enable File Transfr Support
- 91) Enable Local Mode If local mode set true, then -all remote command for binary output/ analog output control statusset to not supported
- 92) Update Check Time Stamp if it true , the timestamp change also generate event during the DNP3update

Server Data Configuration

Server Data Configuration window shows the point list configuration.



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)

Update DNP Datatype Information

The user can update the Point information .The following parameters can change Value, quality bits and according to DNP group, and the change reported to end client system by class / integration polling , unsolicited reporting .

Data_O	bjects_1								
S	Start Communication	Stop C	ommunication					1	
S.No	DNP3 Group Id	Index Number	Value		Quality Bits	Time Stamp	Class	Control Model	
1	BINARY_INPUT	0	0	ONLINE		08:14:21 16/08/2016	CLASS_ONE	STATUS_ONLY	
2	BINARY_INPUT	1	0	ONLINE		08:14:21 16/08/2016	CLASS_ONE	STATUS_ONLY	
3	BINARY_INPUT	2	0	ONLINE		08:14:21 16/08/2016	CLASS_ONE	STATUS_ONLY	
4	BINARY_INPUT		1	ONLINE		08:14:21 16/08/2016	CLASS_ONE	STATUS_ONLY	
5	BINARY_INPUT	Update		ONLINE		08:14:21 16/08/2016	CLASS_ONE	STATUS_ONLY	
6	BINARY_INPUT	5	0	ONLINE		08:14:21 16/08/2016	CLASS_ONE	STATUS_ONLY	
7	BINARY_INPUT	6	0	ONLINE		08:14:21 16/08/2016	CLASS_ONE	STATUS_ONLY	
8	BINARY_INPUT	7	0	ONLINE		08:14:21 16/08/2016	CLASS_ONE	STATUS_ONLY	
9	BINARY_INPUT	8	0	ONLINE		08:14:21 16/08/2016	CLASS_ONE	STATUS_ONLY	
10	BINARY_INPUT	9	0	ONLINE		08:14:21 16/08/2016	CLASS_ONE	STATUS_ONLY	
11	DOUBLE_INPUT	0	0	ONLINE		08:14:21 16/08/2016	CLASS_THREE	STATUS_ONLY	
12	DOUBLE_INPUT	1	0	ONLINE		08:14:21 16/08/2016	CLASS_THREE	STATUS_ONLY	
13	DOUBLE_INPUT	2	0	ONLINE		08:14:21 16/08/2016	CLASS_THREE	STATUS_ONLY	
14	DOUBLE_INPUT	3	0	ONLINE		08:14:21 16/08/2016	CLASS_THREE	STATUS_ONLY	
15	DOUBLE_INPUT	4	0	ONLINE		08:14:21 16/08/2016	CLASS_THREE	STATUS_ONLY	-
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אמש Update DNP3 Data Type				×
Analog_Input		 	1	
Index Number	1			
Value	123.456			
Quality Bits				
ONLINE RESTART		VER_RANGE	REFERENCE_ERR	
		Updat	e Analog Input Point	
			Close	

Traffic window

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

Traffic_1	
Clear Save 1	
	_
8/16/2016 8:17:32 AM	*
Ethernet port (p. 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 1r	
0/10/2010 0.17.22 M ¹	10
5/16/2016 8:17:33 AM	
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	
Ethernet port (p 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 90 01 01 01 01 01 01 01 01 01 01 01 01 01	10
o/ 10/2010 6:17:53 AM Ethernet nort in 127:0.0.1 nort 20000 receive 18 hytes: R <- 05 64 0h 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 01 00 00	10:
8/16/2016 8:17:33 AM	
Ememet port (p. 127, 0.0.) port 20000 receive 27 bytes : K <- 05 64 14 C4 01 00 02 00 4a a2 0a Ca 01 3c 02 06 3c 03 06 3c 04 06 3c 01 06 07 ee	
010/0010 017.03 m/r	10
8/16/2016 8:17:33 AM	
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	
	10
	10
Ethemet bort jp 127.0.0.1 port 20000 receive 27 bytes : R <- 05 64 14 c4 01 00 02 00 4a a2 dc cc 01 3c 02 06 3c 03 06 3c 04 06 3c 01 06 0e 41	=
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 dc cc 81 90 00 01 02 00 00 90 101 01 01 01 01 01 01 01 01 01 01 01 0	10:
8/16/2/16 8:17:33 AM	Ŧ
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In this we can save the traffic, and clear the traffic

Log Window

Log window for internal reference

Log_1	
Clear Save 1	
8/16/2016 7:53:11 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 Stoped 8/16/2016 8:14:30 AM: DNP3 Server Started-Running 8/16/2016 8:23:09 AM: dbOperate() called GROUP ID : ANALOG_OUTPUT Index Number 6 data : 123.000000	*
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In the log, we can monitor the command exchange between server & master, and there is an option to save the log & clear log.

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