IEC 60870-5-101 Protocol Client Master Simulator User Manual

Stack Version: 21.05.008

IEC 60870-5-101 Protocol

FreyrSCADA Embedded Solution

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No.5, BommaiyaSamy Kovil Street, Annanji, Theni, TamilNadu, India

www.freyrscada.com

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Table of Contents

1.	Introduction	2
2.	Add and Delete Client Node	3
3.	Client Configuration	5
4.	Client Data Configuration	9
IE	C 60870-5 Group & Typeid to choose	9
5.	Station Commands	13
6.	Point Command	14
7.	Traffic window	15
8.	Log Window	15

Download Free Demo Evaluation Kit - IEC 101 Development Bundle

New updated Version of IEC 101 Simulator & SDK (Software Development Kit) is available now. In the Development Bundle, We included IEC 104 Server & Client Simulator, Windows and Linux SDK, C# projects, Doxygen documentation and Raspberry Pi, BeagleBone Demo library.

1. Introduction

IEC 60870-5-101 Protocol Client Simulator User Manual

IEC 60870-5-101 (IEC101) is a standard for power system monitoring, control & associated communications for telecontrol, tele protection, and associated telecommunications for electric power systems. This is completely compatible with IEC 60870-5-1 to IEC 60870-5-5 standards and uses standard asynchronous serial tele-control channel interface between DTE and DCE. The standard is suitable for multiple configurations like point-to-point, star, multidrop etc.

Features

- Supports unbalanced (only master initiated message) & balanced (can be master/slave initiated) modes of data transfer.
- Link address and ASDU (Application Service Data Unit) addresses are provided for classifying the end station and different segments under the same.
- Data is classified into different information objects and each information object is provided with a specific address.
- Facility to classify the data into high priority (class-1) and low priority (class-2) and transfer the same using separate mechanisms.
- Possibility of classifying the data into different groups (1-16) to get the data according to the group by issuing specific group interrogation commands from the master & obtaining data under all the groups by issuing a general interrogation.
- Cyclic & Spontaneous data updating schemes are provided.
- Facility for time synchronization
- Schemes for transfer of files- Example: IED's will store disturbance recorder file in the memory, when electrical disturbance is occurred in the field. This file can be retrieved through IEC103 protocol for fault analysis

FreyrSCADA IEC 60870-5-101 Client Simulator was originally developed to test the IEC 60870-5-101 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 Type id ASDU, 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

2. Add and Delete Client Node

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 IEC 60870-5-101 Client Simulat	tor			- F
Main Help				
Add Client Delete Client	18/08/2016 11:47:38			FULL_VERSION
····· Simulator add a new IEC104 Client ulator				
Simulator				
Total Clie	ent Count 0			
S.No		Client Name	Status	Serial Com Port Number

Simulator window shows the status & connected Serial com Port Number.

imulator				
Total Client Count	2			
S.No		Client Name	Status	Serial Com Port Number
1		IEC 101_CLIENT_1	Running	UNBALANCED_MODE
2		IEC101_CLIENT_2	created	

3. Client Configuration

Client Protocol Configuration window shows the actual protocol settings.

Help	-5-101 Client Simulator					
·	elete Client 18/08/2016 11:49:37		FULL_VERSION			
ulator	Simulator IEC101_CLIENT_1 Configuration_1 Data_0	Dbjects_1 Traffic_1 Log_1 IEC101_CLIENT_2 Configuration_2 D	ata_Objects_2 Traffic_2 Log_2			
EC101_CLIENT_1	IEC101_CLIENT_1					
Data_Objects_	Item	Description & Value	1			
Traffic_1	Data Link Mode	UNBALANCED_MODE				
Log_1 IEC101_CLIENT_2	Balanced Mode Test Connection Signal Interval	0				
Configuration_2	Enable UTC	FALSE				
··· Data_Objects_:	Serial Port Number	2				
Traffic_2 Log_2	Serial Bit Rate(Baud)	BITRATE_9600				
L0g_2	Word Length	WORDLEN_8BITS				
	Stop Bits	STOPBIT_1BIT				
	Serial 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					

Configuration Parameters as follows:

- 1. Data Link Mode Data link transmission Unbalanced mode 0, Balanced mode -1
- 2. Balanced Mode Test Connection Signal Interval Data link transmission Unbalanced mode 0, Balanced mode -1
- **3.** Enable UTC Enable UTC time / local time for update the monitoring information & initial database time initialization
- 4. Serial Port Number Serial COM port number
- 5. Serial Bit Rate(Baud) Serial Bit/Baud Rate
- 6. Word Length Serial Word Length
- 7. Stop Bits Serial Stop Bits
- 8. Serial Parity Serial Parity
- 9. Flow Control Flow Control
- **10. Inter Message Delay -** Time between sending and receiving of message only applies after transmitting the message
- 11. Transmit PreDelay Transmit Delay before send

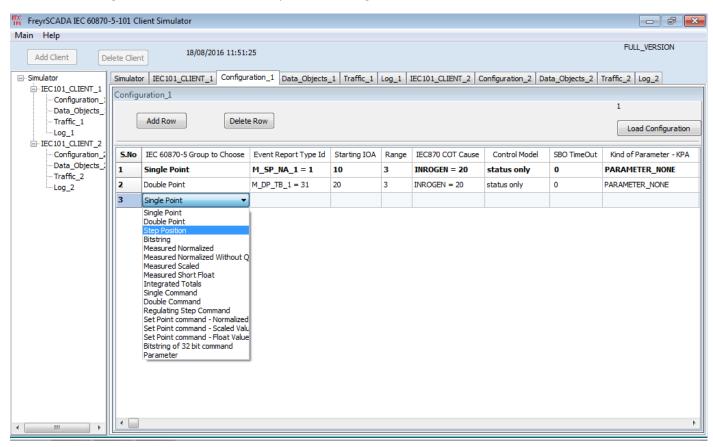
- 12. Transmit PostDelay Delay after send
- 13. Transmit Inter Character Delay Delay between characters during send
- 14. Transmit Character Timeout Timeout if the character is not being sent
- 15. Transmit Character Retries Number of retries to send
- 16. Transmit Message Timeout Message Timeout if entire message is not sent
- 17. Transmit Message Retries Transmit Message Retries to retry the entire message
- 18. Receive PreDelay Delay before receive
- 19. Receive PostDelay Delay after receive
- 20. Receive Inter Character Delay Delay between characters during receive
- 21. Receive Character Timeout Timeout if the character is not being received
- 22. Receive Character Retries Number of retries to receive a character
- 23. Receive Message Timeout Message Timeout if entire message is not received
- 24. Receive Message Retries Receive Message Retries to retry the entire message
- 25. Link Address Size Data link address size
- 26. Data Link Address Data link address
- 27. COT Size Cause of transmission size
- 28. IOA Size Information object address size
- 29. CA Size Common Address Size , one octect, two octect
- **30. Total Number of Stations(Common Address)** Total number of stations in a single physical device/ server, we can run many stations number of stations in our server ,according to common address (1-5)
- **31. Station Address 1 (Common Address 1) -** CA 0 station address 1- Common Address 1, 1-65534, 65535 = global address (only master can use this)
- **32.** Station Address 2 (Common Address 2) CA 1 station address 2 Common Address 2 , 1-65534 , 65535 = global address (only master can use this)
- **33.** Station Address 3 (Common Address 3) CA 2 station address 3 Common Address 3 , 1-65534 , 65535 = global address (only master can use this)
- **34.** Station Address 4 (Common Address 4) CA 3 station address 4- Common Address 4, 1-65534, 65535 = global address (only master can use this)
- **35.** Station Address 5 (Common Address 5) CA 4 station address 5- Common Address 5, 1-65534, 65535 = global address (only master can use this)
- 36. Originator Address if cot size is 2 octect, we need to set originator address, default 0
- 37. Link Layer Timeout Link Layer timeout in milliseconds
- 38. Poll Interval poll interval in milliseconds

- **39.** General Interrogation Interval In Sec if 0, General Interrogation will not send in particular interval, else in particular seconds GI will send to server
- **40.** Group 1 Interrogation Interval in sec if 0, group 1 interrogation will not send in particular interval, else in particular seconds group 1 interrogation will send to server
- **41. Group 2 Interrogation Interval -** in sec if 0, group 2 interrogation will not send in particular interval, else in particular seconds group 2 interrogation will send to server
- **42.** Group 3 Interrogation Interval in sec if 0, group 3 interrogation will not send in particular interval, else in particular seconds group 3 interrogation will send to server
- **43.** Group 4 Interrogation Interval in sec if 0, group 4 interrogation will not send in particular interval, else in particular seconds group 4 interrogation will send to server
- **44.** Group 5 Interrogation Interval in sec if 0, group 5 interrogation will not send in particular interval, else in particular seconds group 5 interrogation will send to server
- **45.** Group 6 Interrogation Interval in sec if 0, group 6 interrogation will not send in particular interval, else in particular seconds group 6 interrogation will send to server
- **46.** Group 7 Interrogation Interval in sec if 0, group 7 interrogation will not send in particular interval, else in particular seconds group 7 interrogation will send to server
- **47.** Group 8 Interrogation Interval in sec if 0, group 8 interrogation will not send in particular interval, else in particular seconds group 8 interrogation will send to server
- **48.** Group 9 Interrogation Interval in sec if 0, group 9 interrogation will not send in particular interval, else in particular seconds group 9 interrogation will send to server
- **49. Group 10 Interrogation Interval -** in sec if 0 , group 10 interrogation will not send in particular interval, else in particular seconds group 10 interrogation will send to server
- **50.** Group 11 Interrogation Interval in sec if 0, group 11 interrogation will not send in particular interval, else in particular seconds group 11 interrogation will send to server
- **51. Group 12 Interrogation Interval -** in sec if 0 , group 12 interrogation will not send in particular interval, else in particular seconds group 12 interrogation will send to server
- **52.** Group 13 Interrogation Interval in sec if 0, group 13 interrogation will not send in particular interval, else in particular seconds group 13 interrogation will send to server
- **53.** Group 14 Interrogation Interval in sec if 0, group 14 interrogation will not send in particular interval, else in particular seconds group 14 interrogation will send to server
- **54.** Group 15 Interrogation Interval in sec if 0, group 15 interrogation will not send in particular interval, else in particular seconds group 15 interrogation will send to server
- **55.** Group 16 Interrogation Interval in sec if 0, group 16 interrogation will not send in particular interval, else in particular seconds group 16 interrogation will send to server
- **56.** General Counter Interrogation Interval In Sec if 0, General Counter Interrogation will not send in particular interval, else in particular seconds GCI will send to server
- **57. Group 1 Counter Interrogation Interval -** in sec if 0, group 1 Counter interrogation will not send in particular interval, else in particular seconds group 1 counter interrogation will send to server

- **58.** Group 2 Counter Interrogation Interval in sec if 0, group 2 Counter interrogation will not send in particular interval, else in particular seconds group 2 counter interrogation will send to server
- **59.** Group 3 Counter Interrogation Interval in sec if 0, group 3 Counter interrogation will not send in particular interval, else in particular seconds group 3 counter interrogation will send to server
- **60.** Group 4 Counter Interrogation Interval in sec if 0, group 4 Counter interrogation will not send in particular interval, else in particular seconds group 4 counter interrogation will send to server
- **61.** Clock Sync Period in sec if 0, clock synchronisation will not send in particular interval, else in particular seconds clock synchronization will send to server
- 62. Command Time out Command Timeout (command ack timeout) in Mille Second
- 63. Server Generate ACTTERM response Signal if server Generate ACTTERM in command respond
- 64. File Transfer Enable Enable File Transmission
- 65. File Transfer Directory Path File transmission folder path, File Transfer Directory Path
- 66. File Transfer Timeout File transmission timeout
- **67. Update Callback Check Timestamp** if true, even the timestamp change will cause the update callback, else only the data & quality field change will cause the update callback

4. Client Data Configuration

Client Data Configuration window shows the point list configuration.



IEC 60870-5 Group & Typeid to choose

- 1) Single Point Single-point information
- M_SP_NA_1 = 1
- $M_SP_TA_1 = 2$
- M_SP_TB_1 = 30
 - 2) Double Point Double-point information
- M_DP_NA_1 = 3
- $M_DP_TA_1 = 4$
- M_DP_TB_1 = 31
 - 3) Step Position Step position information
- M_ST_NA_1 = 5
- M_ST_TA_1 = 6
- M_ST_TB_1 = 32
 - 4) Bitstring Bit string of 32 bit

M_BO_NA_1 = 7 IEC 60870-5-101 Protocol Client Simulator User Manual M_BO_TA_1 = 8

M_BO_TB_1 = 33

5) Measured Normalized - Measured normalized value

M_ME_NA_1 = 9

 $M_ME_TA_1 = 10$

 $M_ME_TD_1 = 34$

6) Measured Normalized Without Quality - Measured normalized value without quality descriptor

M_ME_ND_1 = 21

- 7) Measured Scaled Measured scaled value
- M_ME_NB_1 = 11

 $M_ME_TB_1 = 12$

M_ME_TE_1 = 35

8) Measured Short Float - Measured value, normalized value

M_ME_NC_1 = 13

- M_ME_TC_1 = 14
- $M_ME_TF_1 = 36$
 - 9) Integrated Totals Integrated totals

M_IT_NA_1 = 15

 $M_{IT}TA_{1} = 16$

 $M_{IT}TB_1 = 37$

10) Event of Protection Equipment - Event of protection equipment with time tag CP56Time2a

M_EP_TD_1 = 38, Event of protection equipment with time tag CP56Time2a

11) Packed Start Events of Protection Equipment - Packed start events of protection equipment with time tag CP56Time2a

M_EP_TE_1 = 39, Packed start events of protection equipment with time tag CP56Time2a

12) Packed Output Circuit Information of Protection Equipment - Packed output circuit information of protection equipment with time tag CP56Time2a

M_EP_TF_1 = 40, Packed output circuit information of protection equipment with time tag CP56Time2a

13) Single Command - Single command

C_SC_NA_1 = 45

C_SC_TA_1 = 58

14) Double Command - Double command

C_DC_NA_1 = 46

C_DC_TA_1 = 59

15) Regulating Step Command - Regulating step command

 $C_{RC}NA_{1} = 47$

 $C_{RC_{TA_{1}} = 60}$

16) Set Point command - Normalized Value - Set point command, normalized value

C_SE_NA_1 = 48

C_SE_TA_1 = 61

17) Set Point command - Scaled Value - Set point command, scaled value

C_SE_NB_1 = 49

 $C_SE_TB_1 = 62$

18) Set Point command - Float Value - Set point command, short floating point value

C_SE_NC_1 = 50

C_SE_TC_1 = 63

19) Bitstring of 32 bit command - Bitstring of 32 bit command

C_BO_NA_1 = 51

C_BO_TA_1 = 64

20) Parameter - Parameter

P_ME_NA_1 = 110

P_ME_NB_1 = 111

P_ME_NC_1 = 112

The selection of following parameters based on the typeid selection.

Consider for the following items

	Monitoring information	Control / Command Point	Parameter Value
IEC 60870-5 Group to Choose	Single Point	Single Command	Parameter
Event Report Type Id	M_SP_NA_1 = 1	C_SC_NA_1 = 45	P_ME_NA_1 = 110
Starting IOA	10	100	2000
Range	5	5	5
IEC870 COT Cause	INROGEN = 20	NOTUSED	INROGEN = 20
Control Model Configuration	status only	direct operate	status only
SBO TimeOut	0	0	0
Kind of Parameter - KPA	PARAMETER_NONE	PARAMETER_NONE	PARAMETER_THRESHOLDVALUE
Common Address	1	1	1

5. Station Commands

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

Sta	art Communication	Stop Commu	nication				1
5.No	Common Address	Event Report Type Id	IOA	Value	Quality bits	Time Stamp	IEC870 COT Cause
	1	M_SP_NA_1	10	0	IV NT	12:11:11 18/08/2016	INTROGEN
	1	M_SP_NA_1	11	0	IV NT	12:11:11 18/08/2016	INTROGEN
	1	M_SP_NA_1	12	0	IV NT	12:11:11 18/08/2016	INTROGEN
	1	M_DP_NA_1	20	0	IV NT	12:11:11 18/08/2016	INTROGEN
	1	M_DP_NA_1	21	0	IV NT	12:11:11 18/08/2016	INTROGEN
	1	M_DP_NA_1	22	0	IV NT	12:11:11 18/08/2016	INTROGEN
	1	M_ST_NA_1	30	0	IV NT	12:11:11 18/08/2016	INTROGEN
	1	M_ST_NA_1	31	0	IV NT	12:11:11 18/08/2016	INTROGEN
	1	M_ST_NA_1	32	0	IV NT	12:11:11 18/08/2016	INTROGEN
station Commands point commands				General Interrogat Counter Interroga Clock sync reset process test command File Read			
					Directory Read		

All the station commands can support broadcast address or individual station address,

Station Commands			Σ
			1
General Interrogation		 	
Data Link Address :	1		
Port :	2		
Station Address :	65535		
Interrogation Group	INROGEN = 20 🔻		
			Send GI
			Close

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

6. Point Command

The individual command has point command.

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

Point Command Windo	w	2
Single Command		1
Data Link Address :	1	
Serial Port :	2	
Station Address :	1	
Type id :	C_SC_NA_1	
IOA :	10	
Qualifier	NOADDDEF -	
Command type	OPERATE -	
Value	1	
		Send Single Command
Command Success , errorc	ode 0 - No Error Code, errorvalue 0 - Everything was ok	Close

7. Traffic window

In this we can monitor the traffic of iec104 communication.

In this we can save the traffic, and clear the

traffic

Traffic_1	
Clear Save	1
8/15/2016 7:20:52 PMPort number 1: R <- 10 80 01 00 81 16	
8/15/2016 7:20:52 PMPort number 1: T -> 68 0c 0c 68 73 01 00 01 01 14 00 01 00 0a 00 00 95 16	
8/15/2016 7:20:52 PMPort number 1: R <- 10 80 01 00 81 16	
8/15/2016 7:20:52 PMPort number 1: T -> 68 10 10 68 53 01 00 0d 01 14 00 01 00 14 00 00 00 00 00 8b 16	
8/15/2016 7:20:52 PMPort number 1: R <- 10.80 0100 81 16	
8/15/2016 7:20:52 PMPort number 1: T -> 68 0c 0c 68 73 01 00 64 01 0a 00 01 00 00 01 4 f8 16	
8/15/2016 7:20:52 PMPort number 1: R <- 10 80 01 00 81 16 8/15/2016 7:20:52 PMPort number 1: T -> 68 0c 0c 68 53 01 00 65 01 07 00 01 00 00 05 c7 16	
8/15/2016 7:20:52 PMPort number 1: P < 10 80 00 00 80 10 00 00 00 00 00 00 00 00 00 00 00 00	
S/15/2016 7:20:52 PMPort number 1: T -> 68 00 00 68 73 0100 65 01 0a 00 01 00 00 00 05 ea 16	
8/15/2016 7:20:52 PMPort number 1: R <- 10 80 01 00 81 16	
8/15/2016 7:20:52 PMPort number 1: T -> 68 12 12 68 53 01 00 67 01 07 00 01 00 00 0ad c9 14 13 0f 08 10 88 16	
8/15/2016 7:20:52 PMPort number 1: R <- 10 80 01 00 81 16	
8/15/2016 7:20:52 PMPort number 1: R <- 10 80 01 00 81 16	
8/15/2016 7:21:08 PMPort number 1: R <- 68 0c 0c 68 f3 01 00 65 01 06 00 ff ff 00 00 05 63 16	
8/15/2016 7:21:08 PMPort number 1: T -> 10 00 01 00 01 16	
8/15/2016 7:21:08 PMPort number 1: T -> 68 0c 0c 68 73 01 00 65 01 07 00 01 00 00 05 e7 16	
8/15/2016 7:21:08 PMPort number 1: R < 10.80 0100 81 16	
8/15/2016 7:21:08 PMPort number 1: T -> 68 0c 0c 68 53 01 00 65 01 0a 00 01 00 00 00 5 ca 16	=
8/15/2016 7:21:08 PMPort number 1: R <- 10 80 01 00 81 16 8/15/2016 7:21:17 PMPort number 1: R <- 68 12 12 68 d3 01 00 67 01 06 00 ff ff 00 00 1c 44 15 13 0f 08 10 ef 16	-
0/15/2016 7:21:17 PMPGrt number 1: K < 50 12 20 03 01 00 87 01 00 00 11 10 00 11 14 15 15 01 08 10 81 18 18 8/15/2016 7:21:17 PMPGrt number 1: T > 10 00 00 10 00 11 6	
S/15/2016 7.21.17 PMPort number 1: T -> 68 12 12 68 73 01 00 67 01 07 00 01 00 00 00 1c 44 15 13 0f 08 10 93 16	
8/15/2016 7:21:17 PM of thumber 1: P <- 10.81 0100 81 16	

8. Log Window

Log window for internal reference

.oq_1		
Clear Save	1	
8/15/2016 7:00:52 PM: IEC101 Server Node Config Loaded 8/15/2016 7:00:55 PM: IEC101 Server Started-Running 8/15/2016 7:18:53 PM: IEC101 Server Started-Running 8/15/2016 7:18:53 PM: IEC101 Server Started-Running 8/15/2016 7:19:27 PM: IEC101 Server Started-Running 8/15/2016 7:19:27 PM: IEC101 Server Started-Running 8/15/2016 7:19:55 PM: IEC101 Server Started-Running 8/15/2016 7:19:55 PM: IEC101 Server Started-Running 8/15/2016 7:20:37 PM: IEC101 Server Started-RUNNIEQ Called 8/15/2016 7:20:37 PM: IEC101 Server Started-RUNNIEQ Called 8/15/2016 7:20:37 PM: IEC101 Server Started-RUNNIEQ Called 8/15/2016 7:20:32 PM: IEC00 Server Queded 9/15/2016 7:20:32 PM: IEC00 Server Queded 9/15/2016 7:20:32 PM: IEC00 Server Queded 8/15/2016 7:20:32 PM:		
· · · · · · · · · · · · · · · · · · ·		•

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